WORLD'S FASTEST

Four-Engine Piston-Powered Aircraft

STORY OF THE REPUBLIC XR-12 RAINBOW

Includes the Hughes XF-11 Competitor

Mike Machat

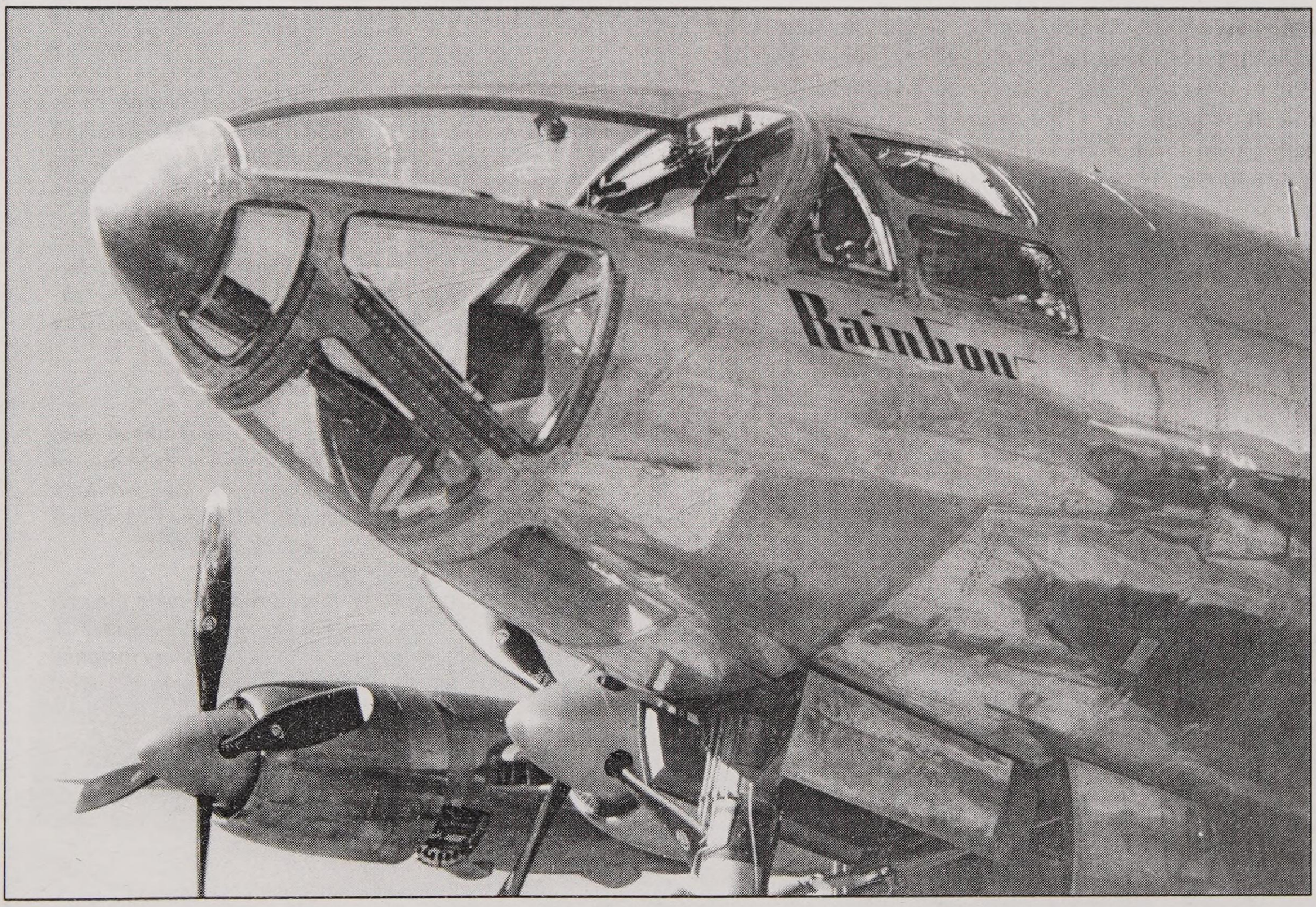
WORLD'S FASTEST

Four-Engine Piston-Powered Aircraft

STORY OF THE REPUBLIC XR-12 RAINBOW

Includes the Hughes XF-11 Competitor

MIKE MACHAT



specialty press
PUBLISHERS AND WHOLESALERS

Specialty Press
39966 Grand Avenue
North Branch, MN 55056
Phone: 651-277-1400 or 800-895-4585
Fax: 651-277-1203
www.specialtypress.com

© 2011 by Mike Machat

All rights reserved. No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without prior permission from the Author. All text, photographs, and artwork are the property of the Author unless otherwise noted or credited.

The information in this work is true and complete to the best of our knowledge. However, all information is presented without any guarantee on the part of the Author or Publisher, who also disclaim any liability incurred in connection with the use of the information.

All trademarks, trade names, model names and numbers, and other product designations referred to herein are the property of their respective owners and are used solely for identification purposes. This work is a publication of Specialty Press, and has not been licensed, approved, sponsored, or endorsed by any other person or entity.

Edit by John K. Lewis
Layout by Monica Seiberlich

ISBN 978-1-58007-202-1
Item No. SP163P

Library of Congress Cataloging-in-Publication Data

Machat, Mike.
World's fastest four-engine piston-powered aircraft : Republic XR-12 Rainbow : / by Mike Machat.
p. cm.
Includes bibliographical references and index.
ISBN 978-1-58007-163-5
1. Republic XR-12 (Reconnaissance aircraft) 2. Research aircraft--United States--History--20th century. 3. Reconnaissance aircraft--United States--History--20th century. 4. Propeller-driven aircraft--United States--History--20th century. I. Title.
TL686.R42M33 2011
623.74'67–dc22

2010053947

Printed in U.S.A.

On the Front Cover:
The magnificent Republic XR-12 Rainbow in flight in 1946. With a top speed of 461 mph in level flight, the Rainbow was the fastest four-engine piston-powered airplane ever built. (Republic via Author Collection)

On the Front Cover (Inset):
The smaller twin-engine Hughes XF-11 was the competing design for a coveted Air Force production contract to build a new high-speed, high-altitude reconnaissance aircraft. (Craig Kaston Collection)

On the Front Flap:
Rare color photo shows XR-12 in flight over Eastern Long Island. Lack of military markings indicates photo was taken before Army Air Forces flight testing had begun. (Harry Gann via Author Collection)

On the Front End Paper:
This pencil drawing by the author depicts XR-12 Ship Two at Farmingdale in September 1948. Aircraft is shown starting engines in preparation for a flight to Wright Field for Air Force testing. (Mike Machat)

On the Title Page:
Undoubtedly the most unique and identifiable feature of the Republic XR-12 was its bullet-shaped nose section. This was actually an aerodynamic Plexiglas fairing covering a much thicker, flat windshield. (Cradle of Aviation Museum via Dennis R. Jenkins)

On the Facing Page:
The sleek XR-12 looked as if it were going 400 mph while still parked on the ramp. Large single main wheels were used to keep the landing gear in the wing, and not in fairings under the inboard engine nacelles. (Republic via Author Collection)

On the Back End Paper:
Original Republic inboard profile drawing of the XF-12 forward fuselage showing part of the 15-man crew for the aircraft's proposed "Ferret Radar" mission. (Republic Courtesy of Tim Williams)

On the Back Cover, top:
XR-12 Ship One takes to the air in a cross-wind takeoff from Runway one-nine at Farmingdale. Note ample surface area of the flaps which covered 60 percent of the aircraft's wingspan. (Cradle of Aviation Museum via Dennis R. Jenkins)

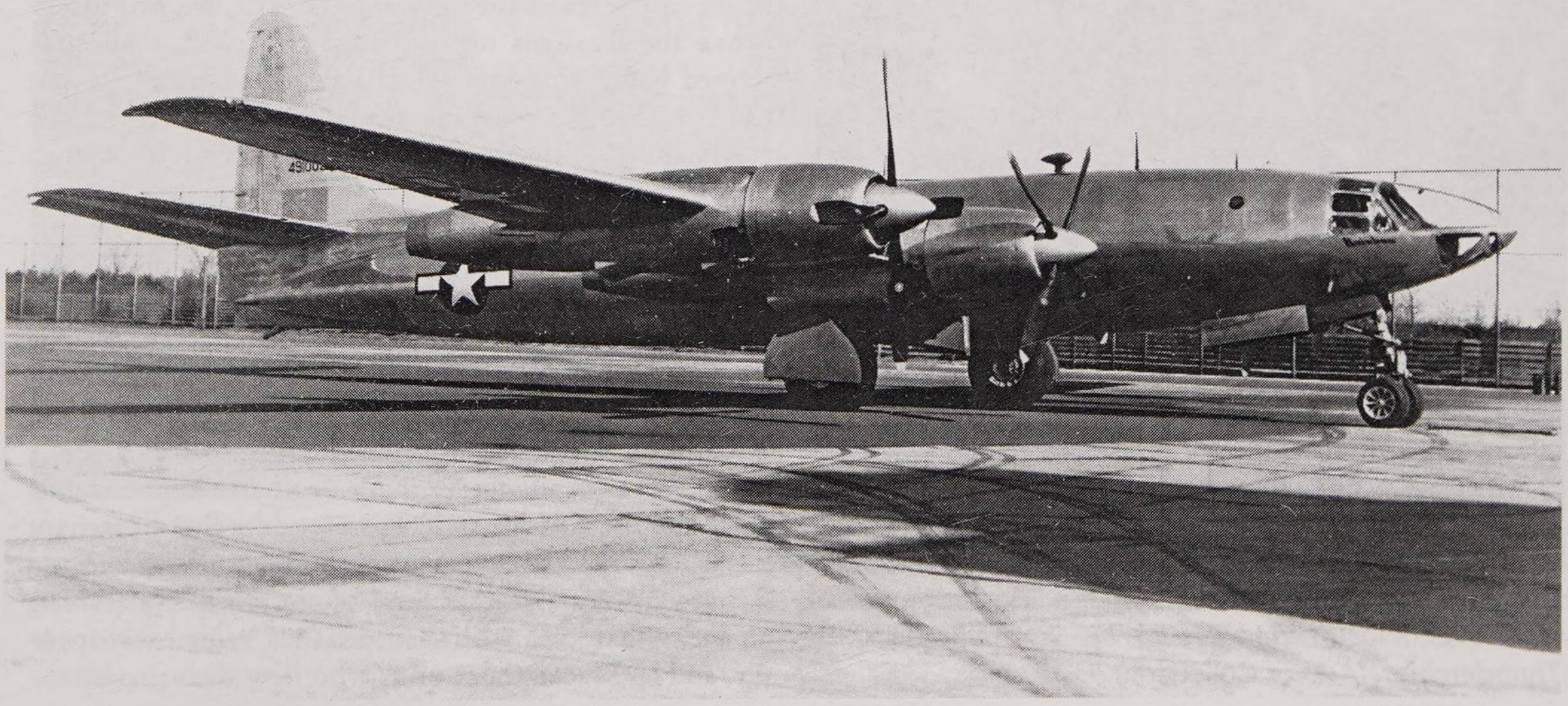
On the Back Cover, bottom:
XR-12 Ship Two as viewed from the balcony outside the cab of Republic's control tower located adjacent to Hangar 3. Note the wing walkway markings and lack of military insignia. (Cradle of Aviation Museum via Dennis R. Jenkins)

TABLE OF CONTENTS

Foreword by Col. Jack Broughton (USAF, Ret.) 4
Author's Preface 8
Acknowledgments 9
Introduction 10

Chapter One Mission Impossible 12
Chapter Two From Seversky to Republic 20
Chapter Three Tough Decisions at Farmingdale 30
Chapter Four Contract, Mockup and Rollout 38
Chapter Five Ship One—Temporary Triumph 56
Chapter Six A Competitor Emerges 68
Chapter Seven Trial by Fire for the XF-11 82
Chapter Eight Airliner Dreams and Realities 92
Chapter Nine Ship Two—A Different Breed 104
Chapter Ten Somewhere Over the Rainbow 116
Epilogue 123

Special Section 132
Bibliography 141
Index 142



FOREWORD

By Col. Jack Broughton (USAF, Ret.)

Having flown a whole lot of fighter hours in all the different airplanes that Republic Aviation Corporation produced—from the P-47 to the F-105—I have often thought about writing a book about Republic. Since I flew those birds for 22 years, I'm probably up around the top in total hours flown in that equipment, and Republic fighters have several times gotten me home after I took severe combat battle damage. I had the opportunity of associating with many of the individuals who made Republic the great outfit that it was, and I saw how the Farmingdale factory functioned.

So why not write that book? Because my friend Mike Machat, superb aviation artist and historian, former owner and editor of two highly respected aviation history magazines, and acquisitions editor for a major publishing firm was far more qualified to write that book. Mike literally grew up with Republic, with family members and friends populating the Republic staff. I knew Mike's uncle who designed the ejection seat that I was glued to through 102 of my F-105 combat missions, and everyone who befriended me at Republic was also one of Mike's friends. Mike was the man to write this book, and when he asked me to open it with a pilot's-eye view of Republic and its fighter aircraft, I was delighted to accept. I hope I can give you a feel for that great organization.

Col. Jack Broughton returns from leading another mission over North Vietnam in his Republic F-105D Thunderchief. (Author Collection)

My first contact with the Republic Aviation Corporation came when, as a newly minted second lieutenant, I joined the 366th Fighter Group in Germany, as War Two came to an end and the Cold War incubated. The entire Army Air Forces went from lots of everything to the point where if I wanted to fly, I had to crew my own Republic P-47 Jug. That seemed dumb to me at the time, but I sure learned a lot about what made the Jug the dominant machine that it was. We also had North American P-51 Mustangs in our outfit, so I got to compare, and quickly recognized flying characteristics that I would see repeated in many Republic fighters in the future. If you are flying a Mustang or a Russian MiG, you can probably turn inside my Republic fighter at low altitude, but I can walk away from you on the deck, and I can wax you at altitude.

If I had to pick a highlight of my many Jug flights, it would be flying on the first fighter mission of the Cold War. We took 72 Jugs, with hot guns, up what was to become the Berlin Corridor, to fly at Berlin's Tempelhof airfield before dignitaries of the four occupying powers. With our R-2800 engines roaring, and our 10-foot paddle propellers rippling the dirt and grass as we approached the reviewing stands, we physically drove the Russians out of the stands, with their red-striped hats flying through the air, to advise them that the P-47 *Yabolts* were still ready to back the American statement that the Berlin Corridor was to remain an open-flight route.

After I became part of the jet set, one of the aircraft I flew was the latest Republic product, the F-84E Thunderjet. Ferrying those new birds from the Farmingdale factory to what was then Las Vegas Air Force Base was the start of my personal association with the RACers. I got to know the wrench benders on the assembly line and the flight line, and to my surprise, I made other friends like Mundy Peale in the president's chair and most of his staff. How could a first lieutenant be so important? But I was important to them because Republic was a different kind of aircraft manufacturer; an entity that lived with their product, valued their people, and embraced those of us who flew their product.

Those ferry flights out of Farmingdale were where I learned to appreciate the fabled dirt sniffer that was built into the nose gear on all of Republic's tricycle landing gear jet fighters. When flying the '84 at Las Vegas, the birds were lightly loaded and the runway was long. Flying a new bird, with a max fuel load, off of a short Farmingdale runway nestled into the confines of suburban Long Island was a bit different. The factory test guys swore by the dirt sniffer, and told us to just go to max power, and let her rip, and when the sniffer smelled the dirt off the end of the runway, she would jump into the air. That is just about how it worked. Additionally, there was a cemetery right at the end of the factory runway, and it was quite stimulating to scan those headstones as you struggled into the air, wondering if your tailpipe would clear the granite.

After flying a Korean combat tour in F-80s, I unexpectedly found myself back in F-84Es on the pierced-plank runway at Taegu, Korea. The Air Force wanted a high-priority combat evaluation of an experimental Swiss air-to-ground rocket, and I eagerly accepted the offer to run that show. Once again Republic came through in style with super support, and delivered six brand-new, modified, and specially instrumented Hogs, ready for war. The birds performed admirably, and the test was a resounding success, despite some nasty combat losses.

When I got back to the States I set up a little red schoolhouse for instructor pilots at Luke Air Force Base, again with Republic tech support. Luke, outside Phoenix, Arizona, was loaded with all models of the F-84, and Republic had a constant flow of modifications in motion to update individual models throughout their active service. There were vast changes and advancements as we switched from one alphabetically tagged model to the next. We even had the one-and-only B model in existence, and I managed a frightening five-minute test hop in that relic before it was hauled away on a railroad flat car. That ride made me appreciate what a good bird the F-84G was.

As boss of the famed USAF Thunderbirds, then-Captain Jack Broughton led the team in several notable movie performances while flying the Republic F-84F Thunderstreak. Here, Broughton (center) poses with his teammates and movie stars Virginia Leith and William Holden (to his left) during filming of the 1956 classic* Toward the Unknown *at Edwards AFB, California. Director Mervyn LeRoy is to Broughton's right. (AFFTC History Office via Tony Landis)

The much anticipated, swept-wing, transonic F-84F Thunderstreak had become entangled in contractual and technical problems, and the straight-wing G model had beaten it to the flight line by a few years. When the first of the Fs finally left the factory they were only halfway Fs, and they wound up at Luke. Swept-wing, near-supersonic birds were supposed to have one–piece horizontal stabilizers to facilitate ease of handling, but just to get the Fs to the flight line, the Air Force and Republic allowed them to come out with old-style two-piece tail sections that were meant for earlier, slower fighters. We were told that it was just an interim fix, so we built up our arm muscles by pulling back on the stick with all our might to keep the F's nose up. The split-tail Thunderstreak was immediately christened the Ultra Hog.

As far as supersonic goes, try full throttle to 35,000 feet, then straight down, throttle still pegged, and if the Mach needle nibbled at 1.0, you were a winner. If that didn't happen by 10,000 feet above the ground, forget it, throttle full back and pull as hard as you could, and hope for a frightening but successful ride to straight and level.

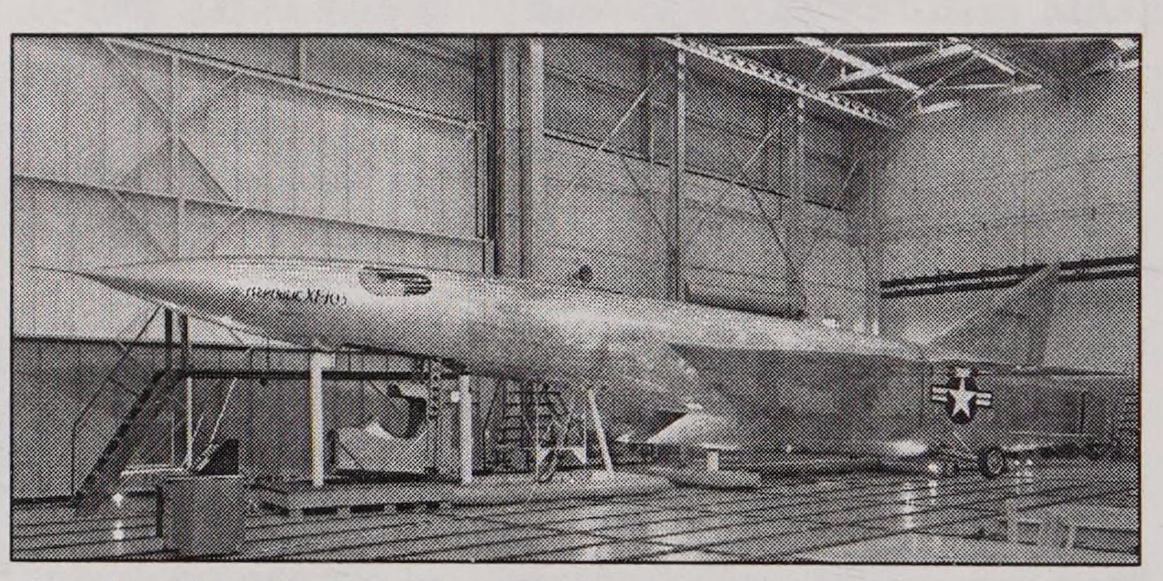
But the split tails were fast, and as the annual coast-to-coast Bendix Trophy Race approached, we got to show the early Fs in a better light. With Republic's help and advice we preened three aircraft for max performance and easily won the Bendix Trophy, which was fun for us, and provided a much needed public relations boost for Republic.

After the Bendix I got to lead the Thunderbirds, the Air Force Flight Demonstration Team, but since the Fs were not ready, we stuck with the established, dependable G models for that demanding mission. The G had been a stout combat warrior in Korea, and she did a great job for the team as we introduced the four-ship Thunderbird acrobatic diamond formation to the world. A year later the F's one-piece slab tail was perfected and we switched to the vastly improved, classy F model Thunderstreaks. With Republic's usual willing help, we were able to switch aircraft without missing a single scheduled air show. There was never a smoother flying air-show bird, and I have the Academy Award nominated short film to back that statement.

The guys at Republic made us feel like regular parts of their team, and they presented us with things like Rolex watches and silver cufflinks and tie clasps, sporting our Thunderbird logo, which was good advertising for their mission and our mission. We were on the road most of the time, and since there was no such thing as advance pay in those days, my enlisted troops were often flat broke in faraway places. As a captain, I repeatedly took my stingy pay down to the bone to help them, but on a long trip, forced to utilize civilian facilities, that was not enough. Republic always had a tech rep traveling with us, and with no fanfare he was always there ensuring that none of my troops were ever hungry or without a cold beer when appropriate.

These days, such relationships between industry and the military user are strictly taboo, and are subjects for constant surveillance, with severe punishment waiting in the wings. Can you believe that despite those freebees, we never even had an opportunity to improperly influence any federal negotiations? However, working together, the Thunderbirds and Republic were able to make millions of spectators, worldwide, more aware of the reality and sophistication of U.S. airpower.

On our factory visits we roamed the Farmingdale facility in comfort. Sometimes we went to the flight line to talk with our life-long friend Bill Sisti and his wrench benders about what they were doing to our birds, or to Manufacturing Vice President Jimmy Roye's office to see what future modifications were in store for our birds. Any talk with Jimmy usually included an invitation to join his gracious family for a feast or a treat. The door to the office of President Mundy Peale was always open, whether to talk about future plans, or to thank him for a deep sea fishing trip. A few doors away we were greeted by his happy secretary Rose, who put our administrative tasks at the top of her priority list, and who diligently searched for anything in print for our Thunderbird scrapbook. Vice President Ken Ellington never turned down a request for public relations help, and his helper Leon Schloss was always fun for an aeronautical history lesson and a highball. Good friends all.



Too far ahead of its time to be a practical weapons system in 1954, the XF-103 gave the world its first glimpse of an ultra-high-performance jet-powered manned aircraft. (National Archives via Dennis R. Jenkins)

My most unusual contact with Republic had to be an invitation to spend some time with design genius Alexander Kartveli in his highly classified inner sanctum. He helped me crawl around and into his super-secret mockup of the futuristic XF-103 interceptor. As expected, it was years ahead of anything else in the field, from its hybrid turbojet/ramjet propulsion system to the elevator required to get to the top of its sky-high landing gear and climb up into the Buck Rogers cockpit, which had only a periscope for outside visibility. When I asked why no canopy, Kartveli replied, "Canopies are ugly, like bumps on pickles." It was truly a look way ahead, with a one-of-a-kind aeronautical pioneer who was also a very nice guy.

As summer faded we got prime exposure opportunities for our Fs with a three-day stop at Farmingdale, followed by three days of performances at the National Air Show in Philadelphia. We flew a morning show at Republic just for the RACers, their families and friends, and we were never more appreciated. Republic's number-one guy, Mundy Peale, took over the public address system to personally introduce our show, and after the show the five of us piled into the back of his big old Cadillac convertible, while he drove us back and forth among the assembled RACers. That was a neat morning.

The afternoon show was open to the public, and every vantage point around Farmingdale was jammed. As we started the show I could see that all the surrounding parkways were saturated with automobiles, all at a standstill. The police supervisor told me later that they had tried to keep traffic moving, but drivers just pulled to a stop and watched the show, so they also parked and watched, as Long Island traffic ground to a halt. That had to be a memorable day for the RACers and for us.

After the show, one of the greatest all-time tributes to our team came from Alexander Kartveli, renowned designer of our Thunderstreaks. After watching the entire show, he shook his head and said quietly, "Now that is flying with a soul, something we cannot design into an airplane." It was quite a profound statement from one of the true legends of aircraft design. Who can say there was no heart and soul in the military-industrial aircraft combine?

When the Korean War was over, American aerospace planners became immersed in nuclear deterrence and Republic's new F-105 Thunderchief was trying to plow through an extremely troubled birthing procedure. Plagued with stop-and-go Air Force requirements, contract vacillation, political hassles, and production slowdowns, the program was indeed in trouble. The Mach 2 F-105 and all its support functions were based on the Air Force requirement for a low-level, high-speed nuclear weapon delivery aircraft, and conventional war options were largely ignored.

Meanwhile, in Indochina, the French were knocked out at a desolate spot in North Vietnam called Dien Bien Phu. It was apparent that the United States would soon be involved in that conflict, but the Air Force did not have a first-line conventional fighter aircraft. As the panic level rose, it was Republic to the rescue, and the Thunderchief, better known as the Thud, had a fast and furious makeover. Its internal nuclear weapons bay and associated delivery hardware disappeared and that space held a large internal fuel tank. External hard points began to carry bombs, rockets, and fuel tanks, and, ready or not, the Thud was at war.

With North Vietnam supported by both the Russians and the Chinese, Thuds faced the fiercest air defenses in the history of aerial warfare, but Republic and the Air Force pushed an endless flow of modifications that made the nuclear delivery vehicle into an outstanding conventional weapons fighter. Republic also rushed in some highly modified two-seat Thuds to specialize in searching for and destroying surface-to-air missile sites. This on-the-spot role reversal allowed Thud drivers to deliver seventy-five percent of all munitions expended against North Vietnam. However, due to political mismanagement, we lost about half of our total Thud inventory, which resulted in death or injury-ridden, inhumane imprisonment for a large number of our heroes.

But all of that had not been enough for Republic, and it had launched in an additional direction. The super-secret chambers that housed the XF-103 mockup I sat in housed something else only a few years earlier—a sleek four-engine machine designated as the XR-12 and called the Rainbow. I was not in on that one, but Mike Machat knows all the details and he has finally cranked out the Republic book I have long thought about. I'm proud that he asked me to recall some of my Republic adventures, and hope they set the stage for this story of the XR-12 Rainbow.

Jacksel M. Broughton, Col. (USAF, Ret.)
Lake Forest, California

About the Author

Mike Machat, a well-known American artist and author, has dedicated his life-long career to the documentation of aviation history. Born and raised in Long Island, New York, he attended Pratt Institute and then served in the U.S. Air Force and with the National Security Agency. Relocating to Los Angeles, Machat earned a Bachelor of Fine Arts degree from California State University, Long Beach, and was hired by the McDonnell Douglas Corporation where he served as Staff Artist and corporate representative.

Machat then established his own aviation art studio and was elected first president of the American Society of Aviation Artists. He was president of the Society of Illustrators of Los Angeles and a senior flight-rated member of the U.S. Air Force Documentary Art Program, contributing twenty-one paintings to its National Collection. Machat also has two paintings in the permanent collection of the Smithsonian National Air and Space Museum, and has painted murals for the Bob Hope Airport terminal in Burbank, California, and the Air Force Flight Test Center Museum at Edwards Air Force Base.

As an aviator, Machat holds an FAA Commercial Pilot License, and has flown in more than 200 different types of aircraft including the T-38, F-104, B-52, F-15, F-16, F-18, and Concorde. He has flown with the Blue Angels and U.S. Air Force Test Pilot School, and was the first Air Force Artist to fly in the Rockwell B-1B Lancer and Grumman F-14 Tomcat in a Navy exchange program. An avid glider pilot, he has accumulated more than 2,000 flights in sailplanes.

In 2001, Machat changed the focus of his career to aviation writing, having served as Editor and Publisher of *Wings & Airpower* magazine, and Acquisitions Editor and author for Specialty Press. He resides in Woodland Hills, California, with his wife Sheri and their two daughters.

Author's Preface

Although I'm writing these words in 2011, this book really began at the traditional Sunday night family dinners of my early childhood nearly 60 years ago. My French grandparents would travel from Manhattan to our home in Rockville Centre, Long Island, and my uncle, George Hildebrand, would pick them up at the railroad station. He was an aeronautical engineer who worked for a small aircraft manufacturing company located in nearby Farmingdale called Republic. After dinner, we would spend coveted time together talking about his latest creations and discussing the more exciting aspects of a career in America's burgeoning aviation industry.

Always illustrating his points with stylish hand-drawn sketches, George's stories held me spellbound as he described the fundamental aerodynamics of supersonic flight, or how a rocket sled traveling 600 mph could be brought to a dead stop in only 200 feet. As I grew older, these after-dinner "chalk talks" grew in complexity, all the while espousing the magic of aviation in the 1950s. Our discussions advanced to subjects as varied as supersonic shock-wave propagation, or the aerodynamics of area-rule design. In ensuing years came the inevitable binge of reading aviation magazines, watching airplane movies, and building countless plastic models, as the seeds of inspiration for my own aviation career were carefully sown.

Specializing in human factors, George was responsible for what he called the "man-machine interface," designing the specific structures and mechanisms of an airplane dealing with pilot enclosure, comfort, and safety. He designed the bubble canopy for the P-47 Thunderbolt, and aircraft windshields and canopies for the XP-69, XP-72, F-84 Thunderjet, XF-91 Thunderceptor, YF-96 and F-84F Thunderstreak, and his favorite of all the Republic fighters, the F-105 Thunderchief.

There were two other airplanes whose nose sections and pilot cabins bore the distinctive imprint of Uncle George's slide rule, and both were rather unique aircraft. The first, a small, single-engine, four-place pusher amphibian named the Seabee, was expected to appeal to the masses of military pilots returning home from the war. More than 1,000 of these popular aircraft were manufactured, and it became George's favorite design because, as he put it, "The Seabee was the only Republic airplane ever built that enabled the pilot to take along his whole family."

The second airplane was a large, sleek, four-engine craft that looked like a bomber, but was actually designed to take high-altitude photographs of enemy territory. It was designated the XF-12, but everyone called it the Rainbow. The craft's distinctive bullet-shaped nose section and cockpit window configuration were Hildebrand designs. He later went on to lead Republic's Escape Systems Group, designing ejection seats for the F-84G, XF-91, F/RF-84F, F-105, and others. George devoted thirty-two years of his life to the Republic Aviation Corporation and held three world patents for his engineering innovations. Although he did not live to see this book published, he was the ultimate inspiration for its being.

ACKNOWLEDGMENTS

There are many valued individuals who deserve special mention, for without their influence, guidance, wisdom, and generosity, this book simply would not exist.

Noted NASA photographer Tony R. Landis and NASA consultant Dennis R. Jenkins have been devoted aviation friends, both of whom contributed greatly to this book. The beautiful profile drawings and aircraft comparisons displayed within these pages are vivid examples of Tony's talented digital artwork, while Dennis supplied copious amounts of research material, imagery, and substantive data that ultimately made the writing of this book possible. Sincere thanks also to Specialty Press CEO Dave Arnold for supporting this project from the very beginning.

Although Republic Aviation Corporation's facilities no longer exist, the company's historical archives thankfully live on. They are housed at the Cradle of Aviation Museum located on the former Mitchel Field in Garden City, Long Island, only a short drive west of Farmingdale. Long-time Curator Joshua Stoff is not only "keeper of the flame," but a gifted historian, author, and administrator. His appreciation for Republic's rich history was instrumental in the creation of this book, and I extend my deepest gratitude for his generosity, time, and effort in making those rare archives available for this project.

Adding their first-hand technical knowledge and personal experiences to this book were several individuals whose lives and careers touched the magical era of this story. Col. Jack Broughton deftly brought the pilot's perspective to his memories of Republic, while fellow author and former USAF and Hughes test pilot George Marrett kindly allowed me the use of his writings. Former USAF and executive pilot John K. Lewis lent his personal experiences to this story, as well as valued photographic support and technical assistance as the Content Editor for my manuscript.

Thanks to famed "X-Hunters" Peter Merlin and Tony Moore for allowing me the use of their meticulous study of the Hughes XF-11 crash. Engineer Craig Kaston contributed unique XF-11 photographs and drawings; English author Tony Buttler supplied many informative technical reports; and former U.S. Navy photo interpreter Elliot Sanders shared details of that important aspect of the photo-recon mission. Thanks also to Jay Miller, Graham White, Tim Williams, Tony Chong, Ryan Crierie, Mike Stowe, and Ed Crawford for their generous photo support, and to fellow author and airliner cohort, Jon Proctor, for use of his writings and input on the RC-2 Rainbow.

To my wife Sheri, and daughters Melissa and Sarah, go special thanks for a lifetime of patience, encouragement, and understanding of the hallowed place aviation occupies in my life. And finally, to the readers of my literary works over the years goes appreciation for your enthusiastic support. I certainly hope this book will be a source of new and exciting information, and I hope you enjoy reading it as much as I've enjoyed writing it.

Mike Machat
Woodland Hills, California

INTRODUCTION

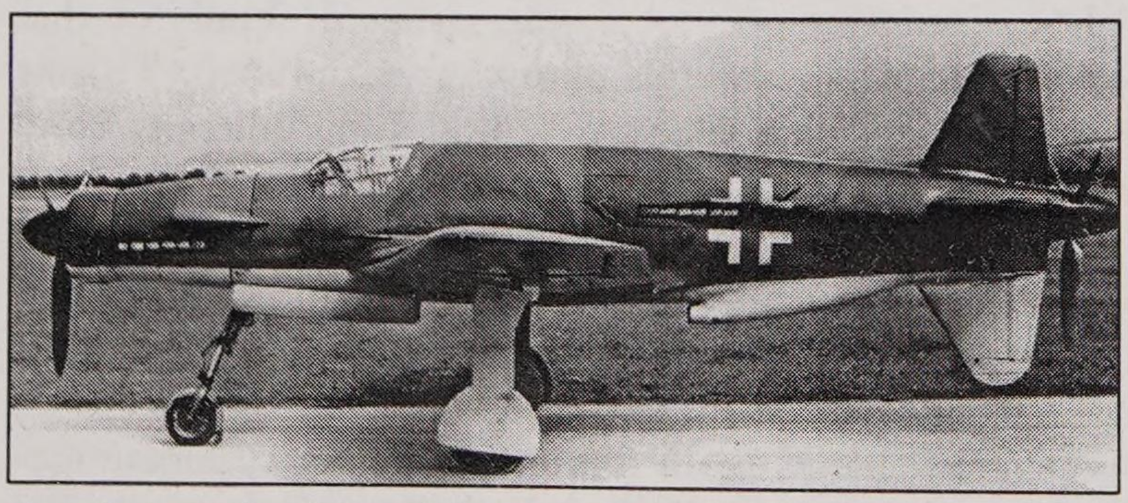
As witnessed with many impressive aircraft programs throughout the twentieth century, a manufacturer who designed, built, and flew the most advanced, most sophisticated, and highest performance airplane wasn't necessarily guaranteed a long-term production contract or that aircraft's operational success. In this book I tell the story of a very significant American aircraft designed during the waning years of World War II to meet very specific requirements for a military production contract. It was then built and flown in the years immediately following the war, and quickly established new precedents for the performance of multi-engine piston-powered aircraft.

Another advanced aircraft from a different manufacturer was also competing for the same production contract, although its design differed greatly from the previously mentioned airplane. Both of these prototype aircraft underwent thorough testing and evaluation by the U.S. Army Air Forces, which transitioned into the new U.S. Air Force during this same period. Surprisingly, neither aircraft advanced to the production stage due to a host of mitigating factors, not the least of which was the sudden and complete obsolescence of the piston engine. As a result, both designs—as advanced as they were aerodynamically—were relegated to the scrap heap of aviation history.

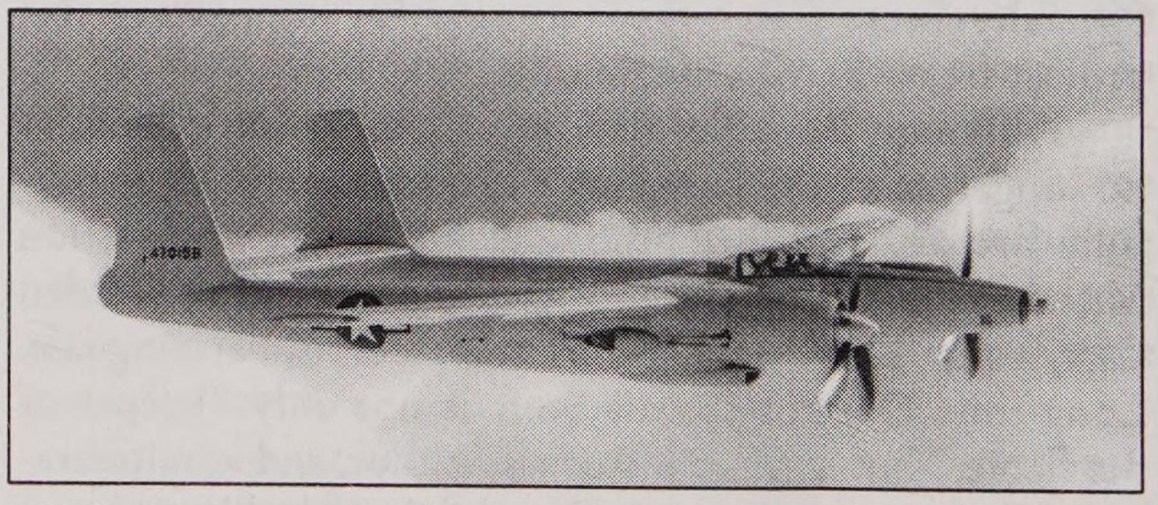
The first airplane, called the XR-12 Rainbow, was built by an established aviation manufacturing company located on the East Coast and nestled in the suburbs of New York City. The brainchild of a Russian émigré who served as that company's legendary chief designer, this airplane was powered by four radial-piston engines housed in long, sleek nacelles mounted on a straight high-aspect-ratio wing. Conventional tailplanes stabilized this aircraft, but its lines were like nothing ever seen before on a large airplane with four reciprocating powerplants. Its bullet-shape nose and teardrop-shaped fuselage implied great speed, while its elongated engine nacelles bespoke great power. This airplane represented the ultimate in both its military mission capability and potential for commercial airline use, and flew successfully for more than half a decade.

The other airplane, simply called the XF-11, was the brainchild of a forward-thinking aviation entrepreneur, a true visionary who saw aviation as a means toward making the United States a more progressive, more advanced, and more powerful nation. With his own manufacturing company located in Southern California, he had the resources and facilities to bring this new design to bear, and created a rather unconventional twin-tail-boom-equipped aircraft with a massive wing, upon which was mounted a small fuselage pod. Unlike the competing Republic airplane, twin radial engines driving contra-rotating propellers were mounted on the front of each tail boom, and a two-man crew was housed in the rather-modest-size fuselage enclosure. This craft, however, had a much shorter flying career for a number of significant reasons.

Although two prototypes of each design were built and flown, not one example of either aircraft exists today, nor do their manufacturers—or their plants, for that matter. Ironically, one XF-11 and one XR-12 were lost during test flights, and then (rather tragically for aviation historians) the surviving airframes were destroyed. Only the Republic airplane was ever flown and operated on the actual mission for which it was designed. Also proposed



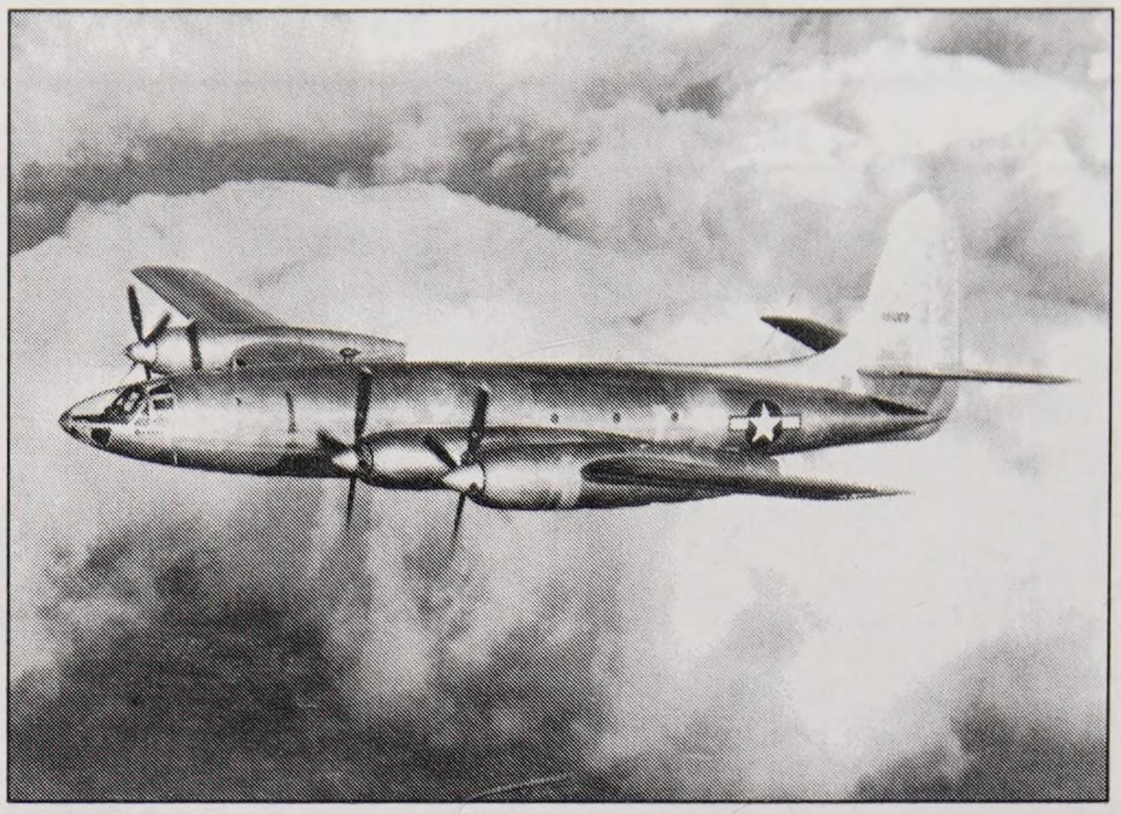
By the end of World War II, several airplanes were thought to hold the title of "World's fastest multi-engine piston-powered aircraft," such as the Focke-Wulf Ta 154 (404 mph), Lockheed P-38 Lightning (443 mph), Grumman F7F Tigercat (460 mph), and de Havilland F3 Hornet (472 mph). Winner of this contest, however, was the German Dornier Do 335 with a top speed of 474 mph. (Via www.military-aircraft-photos.com with permission)



With its top speed of 450 mph, the Hughes XF-11 would certainly be a member of this exclusive club. Although quite a large airframe for a twin-engine piston-powered aircraft, USAAF test pilots at Wright Field found the aircraft to be highly maneuverable with good control response. Despite the massive diameter of its engine cowlings, frontal area of the fuselage was minimal for optimum drag reduction. (Courtesy of Craig Kaston)

as an ultra-high-performance airliner, it would have been a world-beater against any competition at the time. Although the Hughes XF-11 was evaluated by the Air Force and competed directly with the XR-12 for the same stillborn production contract, it was the lesser player of the two aircraft types in this high-stakes saga, due to not having the same operational camera systems. Therefore, the clear emphasis of this book is on the Republic airplane and what took place during its six years of existence.

The right airplane at the wrong time, the XR-12 became another of aviation's mysterious dead ends, and was perhaps one of the most graphic examples of a successful—and in this case *unparalleled*—aircraft not making it into operational service. Considered as its designer's ultimate masterpiece, the Rainbow was one of the fastest, most elegant, and most graceful-looking airplanes ever built. Too much airplane for the post-war commercial airline industry, and not fast enough for its military mission, the XR-12 Rainbow was caught in the proverbial "no man's land" of aviation history at the dawn of the jet age. But for changing military needs, world economics, and timing, it could have been a legend!



When vying for the title of "World's fastest multi-engine piston-powered aircraft," the game changes significantly when two more engines are added. Most four-engine World War II bombers and transports had top speeds of anywhere from 250 to 350 mph. The only four-engine piston-powered aircraft flown at speeds above 400 mph, however, was the Republic XR-12 with its top speed of 461 mph. (Republic via Author Collection)

DEDICATION

This book is dedicated to the employees of the Republic Aviation Corporation. Whether stenographer, factory worker, lab technician, engineer, or test pilot, these devoted men and women toiled night and day to create some of the most memorable and historically significant aircraft ever flown. Anyone who worked at the plant considered themselves part of a small but very special family who always took care of their own. Although this great company no longer exists, the results of their labors helped win World War II, and ultimately made this country, and indeed the world, a better place in which to live.

Chapter One

Photo-recon advanced state of the art, circa 1942. An aerial photographer aims his hand-held camera while sitting in the rear gunner's position of an Army Air Corps Douglas A-24 Banshee (SBD). Photo is captioned, "This member of the first Ground Air Support Command's keen-eyed crew, with the aid of a 'Big Bertha' camera, looks for secret signposts built for enemy planes. It is up to him to translate obscure or innocent looking markings on the ground that are really arrows or figures by which enemy bomber pilots can find their way to war plants and other military objectives." (Acme Newspictures via Author Collection)

MISSION IMPOSSIBLE

"I've spent most of my career wondering what was on the other side of the hill."

— Arthur Wellesley, Duke of Wellington, who battled Napoleon at Waterloo

The story of this book is essentially about the military's need for information. It might be information concerning the size of an enemy's forces, their movement, or their current location. It might be information about the amount of damage inflicted by friendly forces upon an enemy, and how fast that damage was repaired, if at all. In the heat of battle, the type of information highly desired by military leaders would be listed as "all of the above," for that is how war has been waged for centuries. In the formative years of this country, military information gathering began with brave fighters called "scouts" who risked and, oftentimes, lost their lives trying to inform

their military leaders of important and timely information. With the invention of photography in Europe in the 1830s, a means of permanently recording visual images was created. As that technology advanced and merged with the beginning of aviation, the concept of aerial photographic reconnaissance was born.

Although photo reconnaissance ("recon") is considered today as a relatively modern activity, the formal beginning of aerial surveillance in America surprisingly dates back to the Civil War. Noted inventor and professor Thaddeus Lowe, grandfather of the fabled aviatrix and aviation personality Florence Lowe (a.k.a. Pancho Barnes), was involved in supplying the Union Army with hot-air balloons from which aerial observation and early warning operations could be conducted. In World War I, the first major use of aircraft in wartime, observers and photographers were carried aloft in primitive biplanes or stationed in large, tethered, and highly flammable hydrogen-filled observation dirigibles. In either case, casualties ran high and the photographic results were marginal at best. In the untamed barnstorming era of the 1920s, aviation prospered, and the field of high-altitude aerial mapping and photography began in earnest as the U.S. population grew.

In 1917, a young engineer named James Bagley, who was working for the U.S. Army Corps of Engineers, developed the first three-lens camera system for aerial photography. The center lens faced straight down while the two outboard lenses faced outward at an angle. By simultaneously recording three separate images from the multiple lenses on one piece of film, a viewer would see greatly expanded coverage of the ground without any added distortion from a wide-angle lens. A further evolution of this idea resulted in the use of three separate cameras to achieve the same results. Thus, one vertical camera facing straight down at the ground surrounded by two oblique cameras facing outward at an angle could produce a single image covering three times the land area of the vertical camera alone. This configuration would come to be known as the "trimetrogon" camera system.

Perhaps the real credit for bringing aerial photography into the modern age should go to an Army private who enlisted in the Signal Corps in 1917 and attended the first officers' school in aerial photography at Cornell University in upstate New York. Upon graduation, Private George Goddard received his commission and then became an Army aviator in 1919. As the officer in charge of researching aerial photography and mapping at McCook Field in Ohio, Goddard was heavily involved in the development of long-focal-length lenses used for high-altitude reconnaissance. He also pioneered nighttime aerial photography using the light from magnesium flares dropped from a Martin B-10 bomber. Perhaps Goddard's most notable achievement was photographing a U.S. Army Air Corps Boeing B-17 intercepting the Italian ocean liner *Rex* in 1937, proving the Army's capability to defend the U.S. coastline as the storm clouds of World War II were building across the Atlantic. The recipient of numerous awards for his many photographic achievements, Goddard retired from the U. S. Air Force as a brigadier general.

When World War II finally broke out in Europe, aerial photo-reconnaissance requirements were met by outfitting existing aircraft with camera gear, sending those aircraft out over enemy territory, and hoping the "recce" airplanes would return with the desired results. To use the advantage of speed, fighters were generally employed, but for long-range, long-duration missions, large multi-engine bombers had to be converted for that role. What was needed, however, was one airplane that could do everything: fly high, fly fast, *and* cover long distances. During the closing years of the war in the Pacific, the need for such an aircraft became paramount, and the general mission requirement for the Republic XF-12 was born.

The Era of Long-Range Photo Aircraft Begins

"A long range photographic reconnaissance airplane, with a cabin pressurized to maintain a 10,000 ft. altitude, having a high speed of 465 m.p.h. at 40,000 feet, and powered with 4 Pratt & Whitney R-4360-31

For more complex military photo targets, rapid analysis of aerial images is critical to the establishment of tactical priorities. Once the recon ship has landed, immediate photo processing must take place to best utilize the advantage of time. Here, Army Master Sergeant A. F. Matos is setting up a water reservoir for use in a new type of field-portable darkroom tent. The rubber sheet below him actually serves as the floor of the tent, and is waterproof and lightproof as well as acid-proof. The entire apparatus may be carried either by truck, or in the photo plane itself, such as the Army Lockheed C-36A visible in the background. Note Wright Field test markings on the Lockheed's rear fuselage and background completely painted out in this highly retouched photograph. (Acme Newspictures via Author Collection)

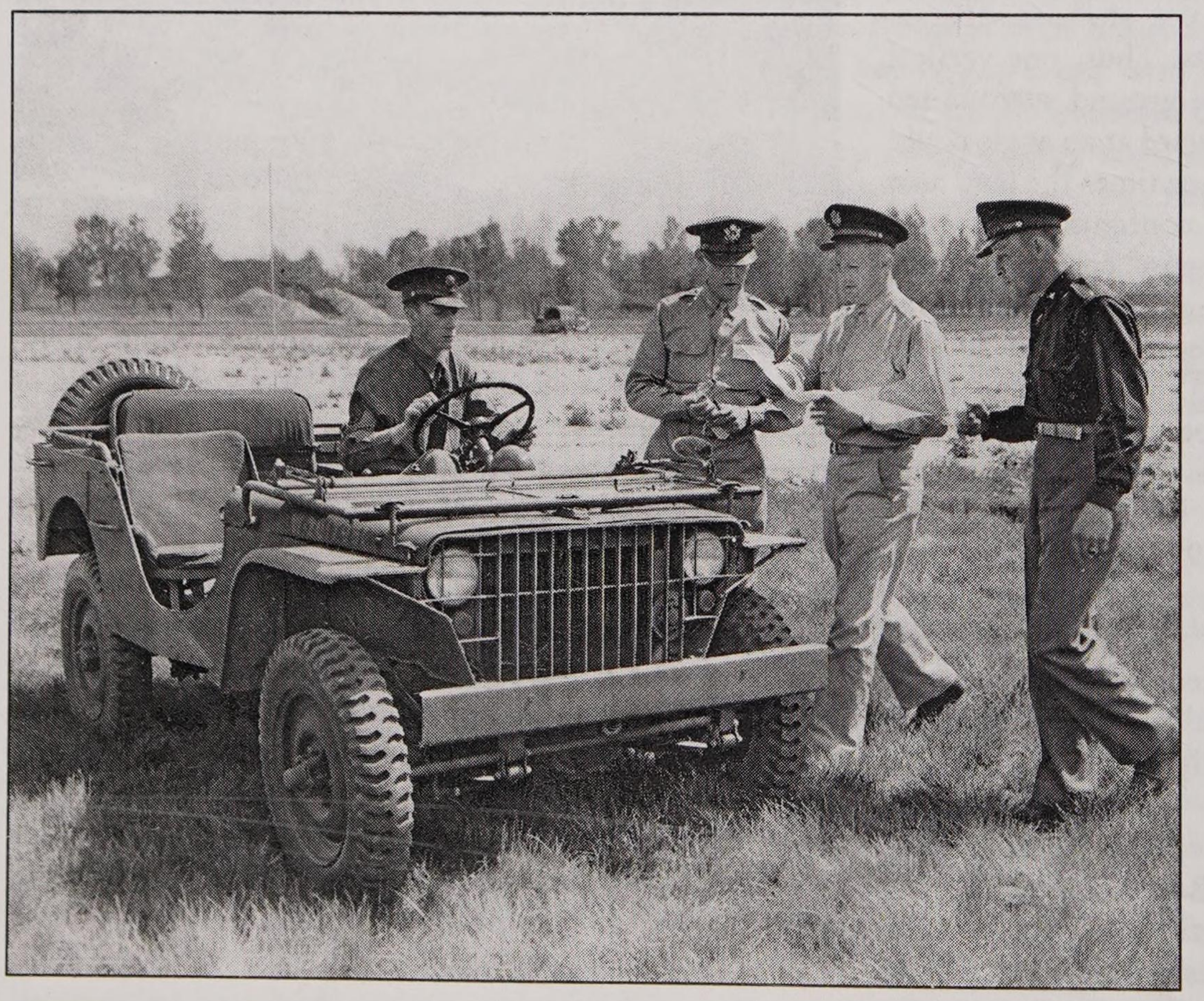
engines." So began the "Case History of [the] XF-12 Airplane" compiled in January 1946 by the Army Air Technical Service Command, Wright Field in Dayton, Ohio, and Headquarters, Army Air Forces, Washington, D.C. In this originally classified document, a complete summary of the XF-12 Program, from its inception in January 1943 to the projected inaugural flights of the first of two prototype airplanes, was covered in minute detail. To gain a proper understanding of this breakthrough aircraft and its place in aviation and military history, however, one must examine the state of the art in photo reconnaissance at the beginning of World War II.

Prior to January 1943, the U.S. Army Corps of Engineers had been pressing for the development of a long-range, high-speed, and high-altitude airplane capable of furnishing aerial intelligence and photographic surveillance, or "aeronautical charting," as it was referred to in those days. The lack of suitable photographic coverage in the battlefield had been the subject of a scathing report filed by the adjutant general in Washington, D.C., which directed that action be taken to correct the deficiency in this area, and to provide suitable equipment and trained personnel to operate improved aerial intelligence systems as soon as possible.

For the U.S. Army Air Forces, converting existing types of aircraft into photo-recon platforms had been common practice to that point. The twin-engine, twin-tail-boom Lockheed P-38 Lightning had been converted into the "droop snoot" F-5, its F designation denoting "photographic." While this aircraft had served admirably in the Southwest Pacific and Far East theaters, including in the role of primitive electronic intelligence (ELINT) gathering, its combat operating range was fairly limited. For longer-range missions in the Pacific region, four-engine Boeing B-17 Flying Fortress and Consolidated B-24 Liberator bombers were converted to the photo-reconnaissance role, while in the European Theater, British de Havilland Mosquitoes designated as Merlin 61s were pressed into photo-recon service, as were North American's P-51 Mustangs, which became the F-6 in the photo-recon mode.

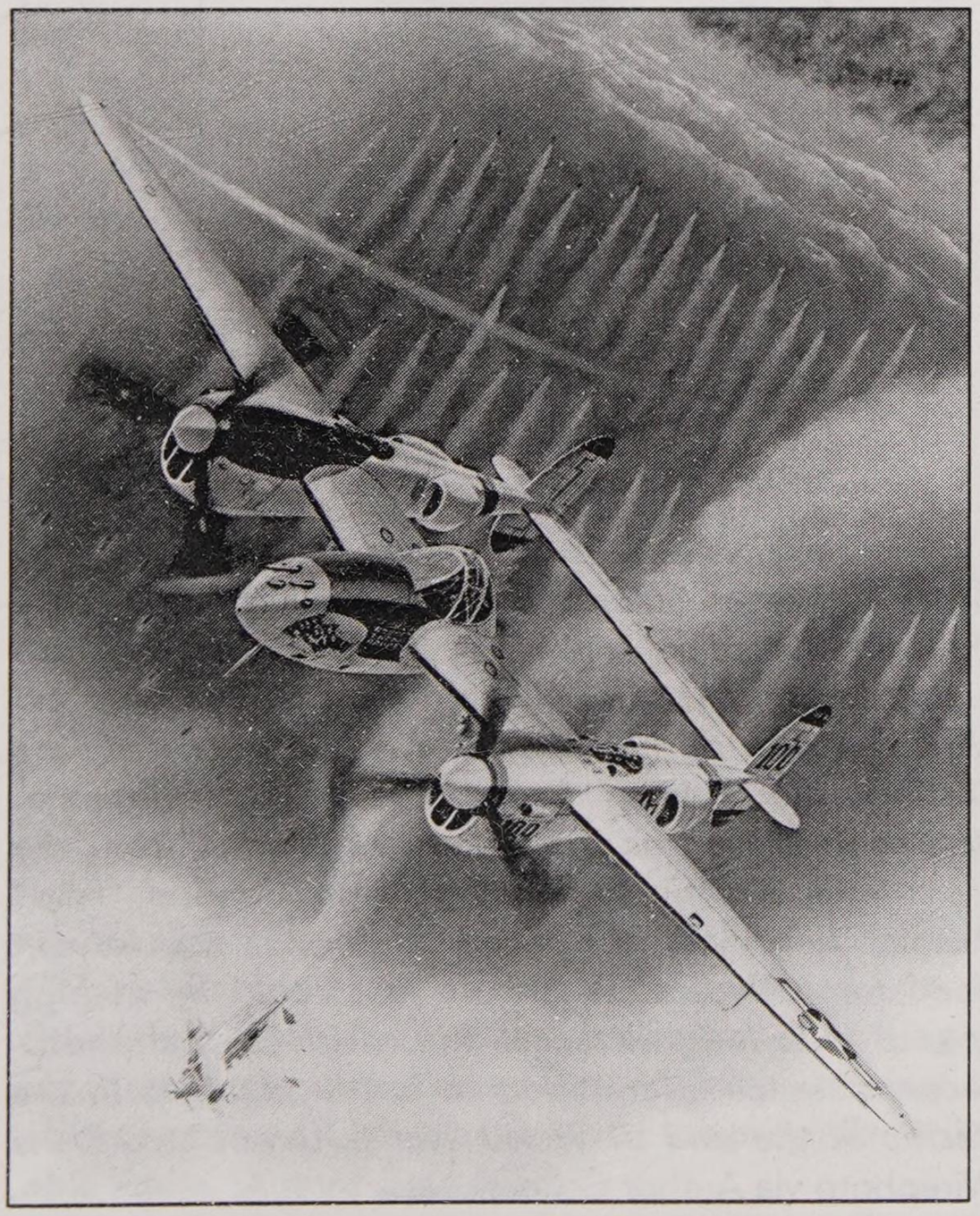
During the final years of the war in the Pacific, the need for long-range photo-reconnaissance capability became even more acute. The loss of bases in China put many strategic targets out of range, and Boeing's new B-29 Superfortress was converted for the recon role and designated the F-13. Despite having this airplane in the arsenal, there was still noticeable disagreement between the Army Air Forces and the Corps of Engineers over which direction to take—conversion of existing aircraft or the development of a brand-new one from a "clean sheet of paper." The War Department General Staff finally determined that the development of a brand-new airplane with performance capabilities that exceeded anything flying at the time would be the direction to take.

By April 1943, tentative performance characteristics for this new airplane had been established by the Aerial Mapping Committee in Washington, D.C., and were found to be well beyond anything that could have been considered as "the next logical step" for large, multi-engine piston-powered airplanes of that time period. Discussions to realistically define these characteristics



In an Army jeep aptly named the "Blitz Buggy," a sergeant delivers the newly developed photographs to staff intelligence officers for analysis. As the photo caption enthusiastically describes, "The speed and efficiency of operations, from the time the picture is taken to the time it is received by the commanding officers, would leave little time for the 'enemy' to change their positions, and the chances of a successful attack or counter-attack would be greater." One can't help but wonder what these officers would have thought had they been able to see real-time reconnaissance imagery downloaded from satellites orbiting in space today. (Acme Newspictures via Author Collection)

An actual moment in time is captured in this painting by the author, showing the use of low-level photo reconnaissance to verify an aerial "kill" during the closing months of World War II. F-6D photo Mustang pilot Capt. Clyde B. East was flying a recce mission over Germany on 8 April 1945 when he spotted an enemy Heinkel He 111 and shot it down. The German bomber crash-landed in a cabbage field, and East used the Mustang's Fairchild K-17 vertical camera to take a verification photo of his aerial bounty. Note markings on the left wing specific to the F-6D, comprised of three crosshairs and angled stripes on the leading edge. The pilot would sight those crosses and hash stripes through matching marks etched in the fighter's canopy to show focal length and wind drift, respectively. Round port for the F-6D's oblique fuselage camera can be seen just aft and below the national insignia. This painting could only be titled "Photo Finish!" (Mike Machat)



Another Army Air Forces fighter employed for high-speed photo reconnaissance was the Lockheed F-5 Lightning, based on the P-38 fighter. With their cameras installed in a bulkier nose assembly than on the sleek, machine-gun-equipped P-38J seen here, the photo Lightnings were called Droop Snoots. Although F-5s could fly at speeds of up to 360 mph, their operating range on photo missions was only 150 miles according to government reports. Approximately 1,400 photo-recon Lightnings were either factory built or converted from the fighter configuration. Some were even equipped for the first ELINT missions flown by the Army Air Forces. (Mike Machat)

continued in earnest through summer 1943, and by October the specific parameters for this new long-range "photographic airplane" were expressed more in terms of specific desired objectives, rather than overall concept.

It is interesting to note that one of the most distinctive features you will see on the subject aircraft of this book was actually specified as a mandatory requirement for the new "high-altitude photographic airplane," three years before that aircraft ever flew. The XF-12's highly streamlined bullet-shaped nose section was essentially a clear tapered fairing mounted ahead of a thick flat-glass bulkhead that also served as the leading edge of the cabin's pressure vessel. This nose section was perhaps the most distinctive visual feature of the airplane, yet the specification for its existence was written on 30 June 1943 by the Chief of the Aircraft Laboratory, Army Air Forces Materiel Command. His report findings read as follows:

> *"For a photographic airplane of this nature . . . visibility for the pilots is number one in importance. It is desired that the pilots have 180 degrees [of] forward visibility. This would require a complete plexiglass nose with instrument boards mounted between, or to the sides of the pilots."*

A President's Son Weighs In

Unlike today's current crop of national politicians with no military service experience whatsoever, the son of the president of the United States chose to serve his country during World War II. Elliott Roosevelt, the fourth of Franklin and Eleanor Roosevelt's six children, was commissioned as an officer and pilot in the Army Air Forces, and commanded photo-reconnaissance units in England, Italy, and North Africa where he received the Distinguished Flying Cross from 12th Air Force Commander, Maj. Gen. Jimmy Doolittle. As commander of a squadron flying Lockheed F-5 Lightnings, Colonel Roosevelt was well aware of the limitations of converting existing aircraft for the photo-recon role, and upon his return to the United States, vociferously recommended to Chief of Staff General "Hap" Arnold that an entirely new aircraft be developed. Roosevelt then set out to survey U.S. aircraft manufacturers in the hope of formulating specifications of such an aircraft. His attention eventually focused on the Hughes Aircraft Company in Culver City, California.

Roosevelt's recommendations were given credence by the existence of a secret design being developed by Howard Hughes (covered in more detail later). Called simply the D-5, this advanced design was an outgrowth of the all-wood Hughes DX-2 airplane developed independently by that company in 1942 as a high-performance light bomber and photo-recon platform. Roosevelt was insistent that the Hughes project be given government backing, and concurrent support for this airplane was also being generated at the Photographic Section of the Army Air Technical Service Command, headquartered at Wright Field. In August 1943, Roosevelt made his formal recommendation to General Arnold for the Hughes aircraft, stating that the "D-5 was the only airplane designed that was suitable for photographic purposes."

In September 1943, detailed military characteristics of the new photographic airplane were proposed and recommended by the Air Technical Service. Along with the Hughes D-5 proposal was another airplane under development by Lockheed called the XP-58, an enlarged and more advanced version of its legendary P-38 Lightning. Soon, these two competing designs were locked in a battle for a proposed production contract, but under intense scrutiny, it was determined that the smaller Hughes manufacturing facilities were insufficient to support long-term production of such an advanced airplane as the D-5. Other problems arose with the XP-58, and it soon became apparent to the Materiel Command that a formal design competition would ultimately be required to determine which U.S. aircraft manufacturer would be best suited to design and produce the optimum airplane for the mission.

In October 1943, the Office of Commitments and Requirements of the Air Technical Service Command formulated the final design specifications for the new

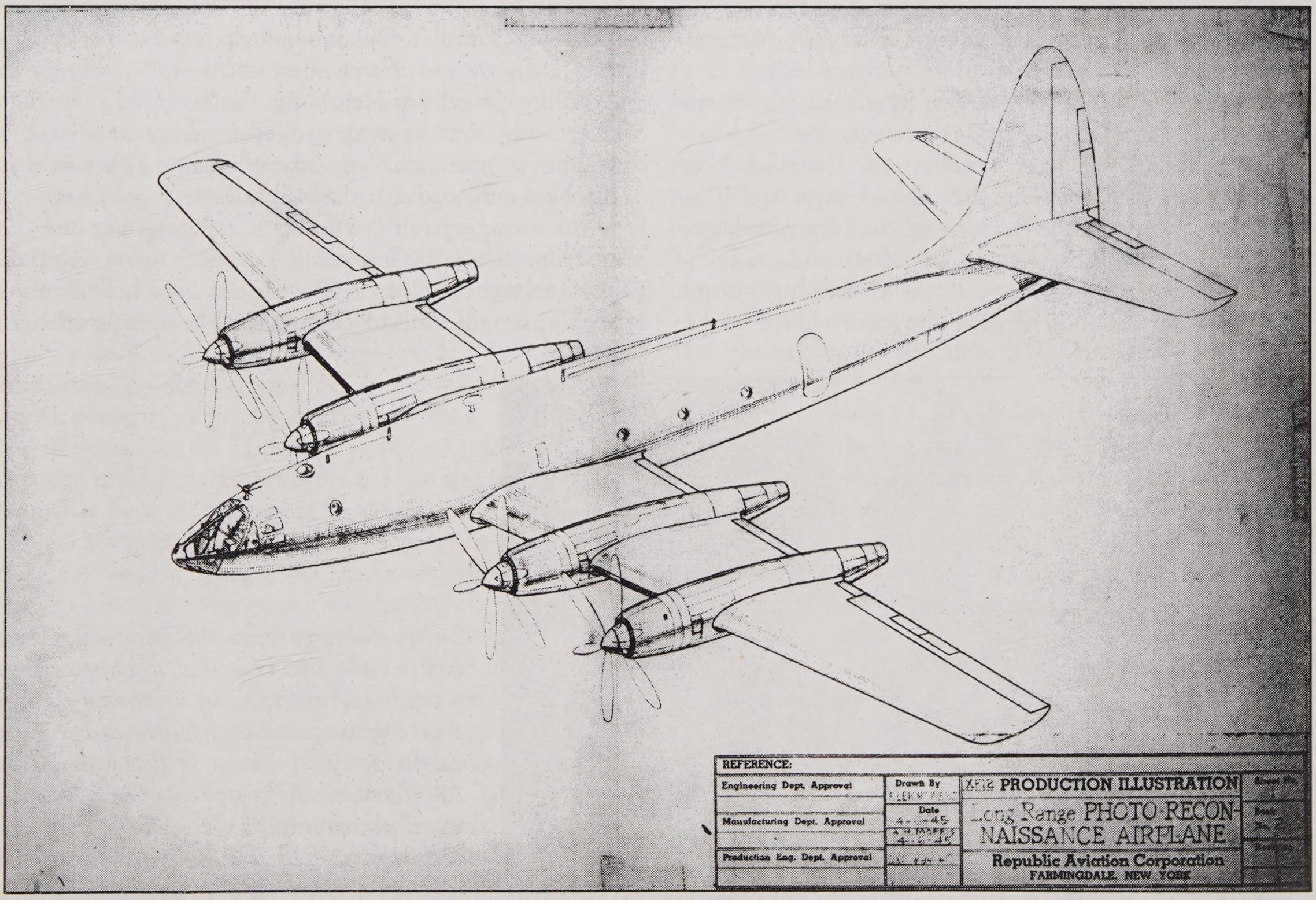
Army Air Forces Colonel Elliott Roosevelt quickly rose through the ranks while commanding aerial photo units throughout the North Atlantic, Europe, and North Africa during World War II. Awarded the Distinguished Flying Cross for his achievements, Roosevelt served as the necessary conduit from the front lines directly to Chief of Staff General "Hap" Arnold. Roosevelt convinced Arnold of the fervent need for a dedicated aircraft that could fly at high speeds over long distances to provide critical photo-reconnaissance information to battle planners in the Pacific at the end of World War II. (Associated Press Wirephoto via Author Collection)

photographic airplane, and then issued a formal Request for Proposals (RFP) to the manufacturers. Specifically, this new aircraft would have to be capable of flying at a minimum high speed of 400 mph (equal to the highest-performance USAAF fighters of the time), and at a service altitude of 40,000 feet. Minimum range was to be 4,500 miles, and it was stipulated that the airplane would carry no guns or bombs, and would be equipped with very little armor plating, if any. (This last specification was amended for the XF-12.)

Aircraft manufacturers submitting proposals included the Hughes and Boeing aircraft companies on the West Coast, and Republic Aviation Corporation on the East Coast. The Hughes D-5 design was ultimately discarded in favor of a larger all-metal twin-engine aircraft called the F-11, while Boeing proposed a modified experimental version of the B-29. Like Hughes, Republic had already been working on preliminary design studies for this airplane, and had proposed initial concepts for a long-range high-altitude transport aircraft suitable for modification to the photo-recon role. It is most interesting to note that even at this very early stage, Republic acknowledged that its airplane might also have very practical application for use as an ultra-high-performance commercial airliner.

Response from Republic — A Concept is Born

On 11 January 1944, Republic delivered its formal proposal for the long-range photographic airplane, which covered the design and manufacture of two prototype aircraft at a total cost to the government of $6,498,600. Delivery of the first airframe was to be made 12 months from the date the contract was approved. The aircraft would have a fully pressurized cabin to carry a crew of four to seven men, and would be powered by four Pratt & Whitney 28-cylinder radial engines known as the R-4360 Wasp Major. Each engine would be equipped with two General Electric BN-1 turbo-superchargers, and would drive a set of three-blade Hamilton Standard superhydromatic dual-rotation (contra-rotating) propellers that were 16 feet 2 inches in diameter. After discussions with Materiel Command authorities at Wright Field, a second proposal from Republic provided for equipping the airplane with Aeroproducts dual-rotation propellers.



Original Republic engineering drawing dated "4-6-45" showing the long-range photo-reconnaissance airplane fitted with eight dual-rotation propellers consisting of three blades each with two sets per engine. This contra-rotating configuration was called for in the original Army Air Forces specification in January 1943, but was later abandoned when late deliveries of the propeller units were in jeopardy of delaying the program beyond acceptable limits. (Author Collection)

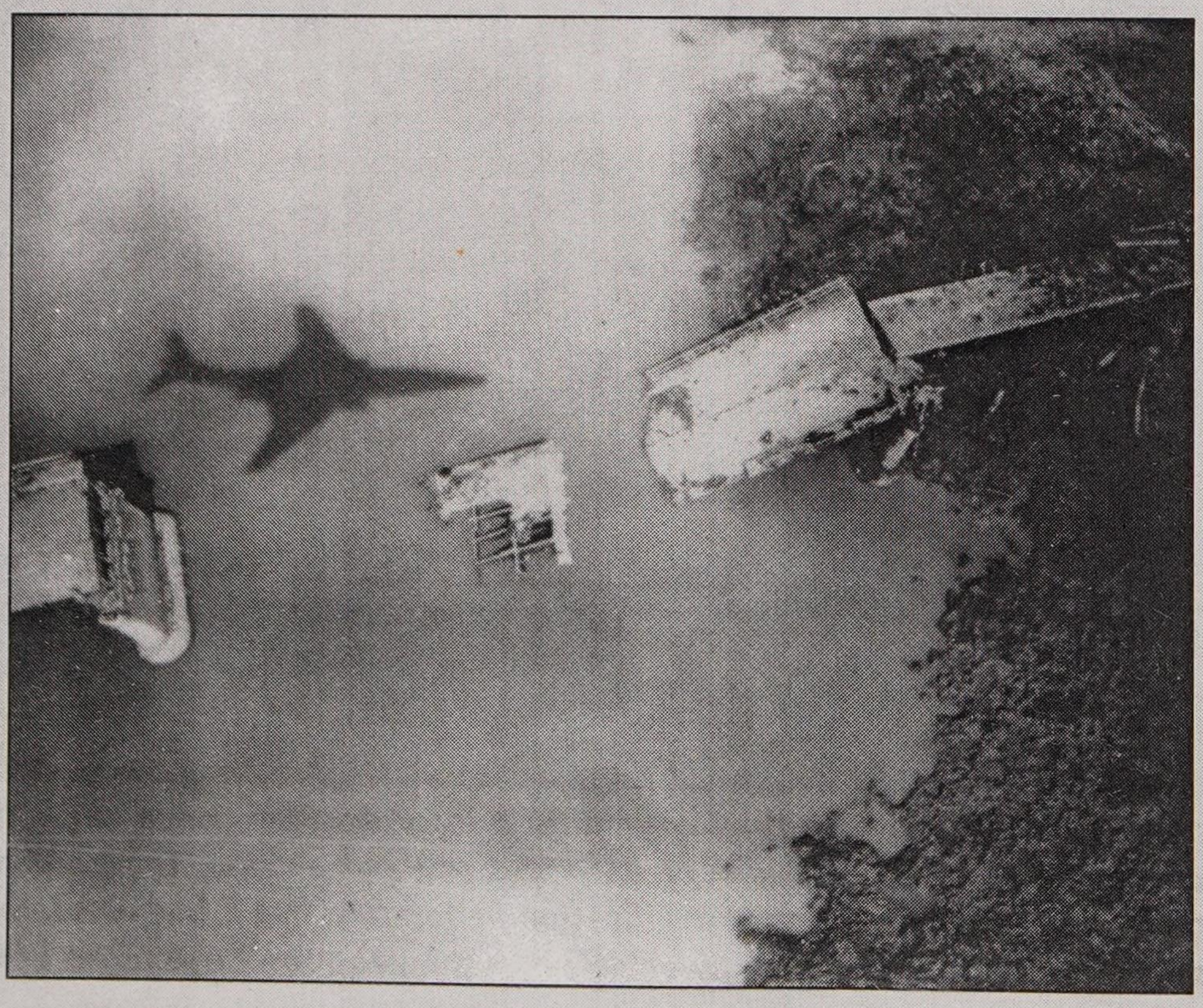
The Fine Art of Photo Interpreting

An interview with former U.S. Navy photo interpreter Elliot Sanders revealed many fascinating insights about the science, if not fine art, of military photo interpreting. Sanders served both on land bases and shipboard during the Vietnam War, and although he performed his craft in a more modern era than that in which the XF-12 existed, the fundamentals of acquiring, identifying, and analyzing tactical information from photographic imagery remained fairly constant. It is also interesting to note that technological advances experienced during his tenure would have been viewed as pure science fiction by any photo technician assigned duty aboard the Republic F-12A photo-recon aircraft.

Enlisting in the Navy in 1966, Sanders was selected for a highly classified training program conducted at Lowry AFB, Colorado. As part of a small contingent of Navy students on base, he trained in the same secure compound used for the development of the secret and crucial Norden bombsight used in World War II. Studying such topics as photo imagery identification and analysis, film processing, handling of classified material, and the basics of aerial navigation, students learned how to accurately plot military targets by identifying "items of interest" in different locations on a map. By using specific visual cues such as colors of terrain or other noticeable changes in the topography, photo interpreters (PIs) could ascertain if roads were being used by vehicles or personnel. Military draftsmen would then add nomenclature and ground-feature callouts to the photo prints for further explanation of what was shown in the image.

In operational mode, PIs tracked activity over a certain period of time and within certain military sectors on a map. When potential targets were identified, their reports were passed up the chain of command. After those reports were studied by their commanders, air strikes were called in to eliminate the targets, and then further photo reconnaissance was used to verify that the strikes were successful and to assess bomb damage. Operating out of a large secret compound in the Philippines disguised as a supply depot, Sanders served in a Navy photo processing facility that contained a massive photo library, processing labs, a photo interpretation center, and mission planning facilities. Later stationed aboard the USS *Ticonderoga* (CV-14), he supported photo-recon operations flown by RF-8P Crusaders, RA-5C Vigilantes, RA-3D Skywarriors, RF-4B Phantoms, and A-7D Corsair IIs equipped with external camera pods.

Effectively demonstrating how a series of photographs taken over time played a role in understanding critical tactical situations, Sanders shared the story of how PIs discovered the clandestine use of an enemy railroad bridge in busy Haiphong Harbor. A large span of that bridge had been destroyed in a successful air strike, but unmistakable use of rail lines on either side of the river indicated that the visible damage was somehow not stopping rail traffic from bringing war supplies from China. Using imagery taken from Ryan BQM-34 Firebee photo-recon drones launched from Navy ships in the Gulf of Tonkin, the PIs were puzzled



Battle damage from U.S. air strikes is shown in this low-quality photo of a downed bridge span on the My Duo highway in North Vietnam taken by an Air Force McDonnell RF-101 Voodoo in April 1965. Keen-eyed photo interpreters analyzed these images to provide vital information to commanders in the field who would then assess the damage and plan further action if necessary. (USAF photo courtesy of Col. Jack Broughton)

to see daily photos of the downed bridge span, yet with rail traffic continuing ashore. During one mission where particularly heavy anti-aircraft fire was being directed at the Firebee, the small but nimble jet aircraft was "jinking" heavily (the aerial equivalent of bobbing and weaving) to avoid flak. At the exact moment the drone banked hard over, its belly camera caught a glimpse of an unusual structure hidden in jungle foliage next to the riverbed. Photo analysis confirmed that it was the portable span of a railroad bridge being used covertly at night to ford the river and allow the enemy rail supply line to operate!

Sanders also told the story of how representatives from Texas Instruments worked with his group in developing the first infra-red (IR) photographic capability used in wartime. By photographically indicating heat signatures emitted from ground entities such as hot engines in ground vehicles, previously undetectable truck convoys became visible at night. Although resolution was still pretty basic when the system was first introduced in 1968, this new technology allowed PIs to work with imagery taken on a 24-hour basis, and the term "under the cover of darkness" began to be purged from the military vocabulary.

Another new technology employed for the first time in Vietnam was laser-guided weaponry, and Sanders' group created what was known as a "mosaic" derived from multiple individual photographs stitched together to show the progression of a specific event. In one case, it was the deployment of an early-generation GBU-10 laser-guided 2,000-pound bomb being launched from the inboard wing pylon of a McDonnell F-4B Phantom II. Although the weapon launch was shown over an entire series of photos, the background remained consistent throughout, giving the viewer the impression of seeing a moving slide show in one large image. That composite photograph was reviewed by staff officers at the Pentagon in Washington D.C., and even wound up on the desk of then–President Lyndon B. Johnson.

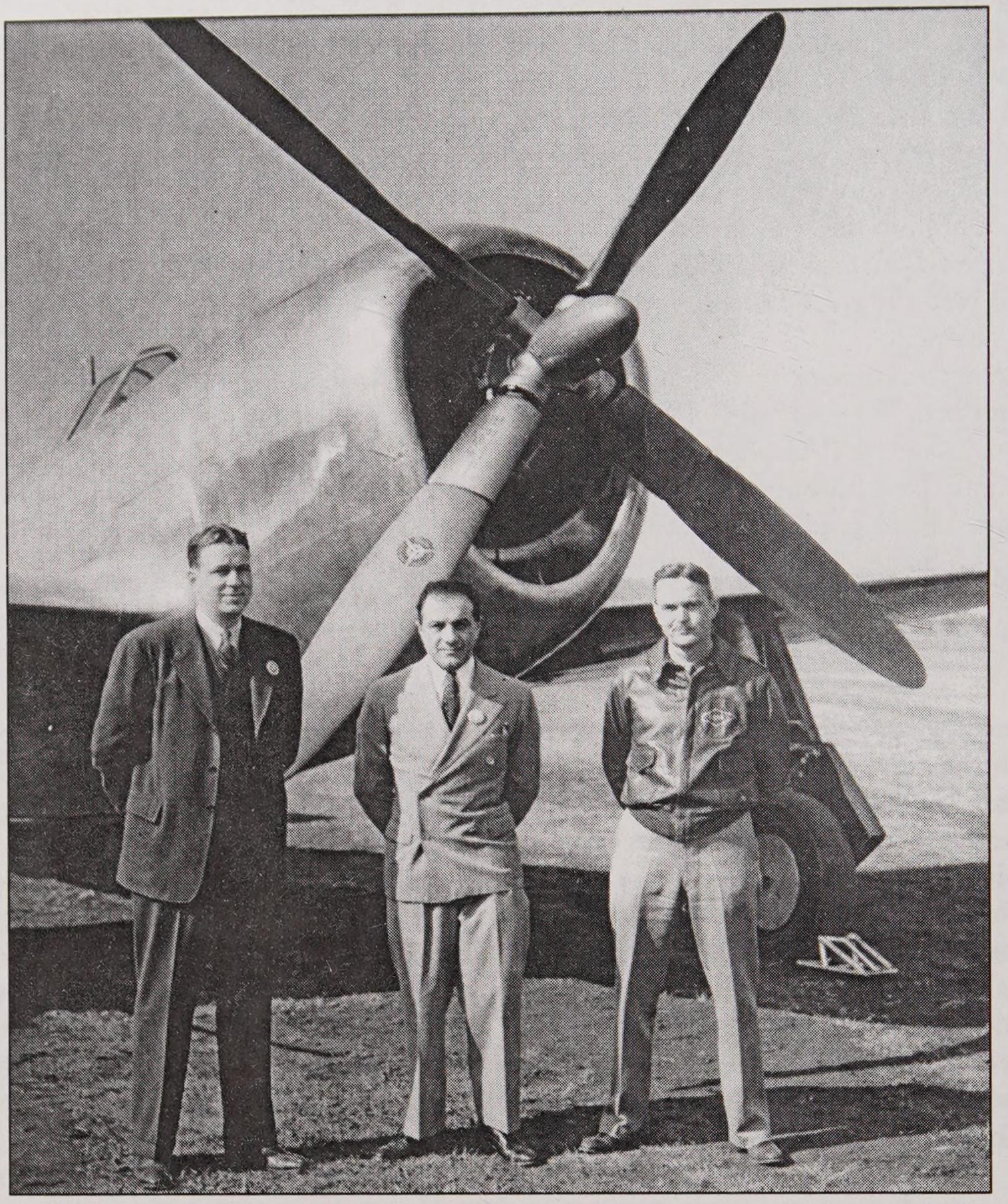
The issue of choosing propellers coupled with problems associated with the complexities of a dual-rotation system soon began to plague the XF-12's initial development. The Aeroproducts propeller became the first choice for use on this airplane, but was considered at the time to be an experimental design similar to a smaller, but operationally proven model. By October 1944, it was becoming apparent that a different propeller would have to be chosen due to repeated slippage in the Aeroproducts' delivery schedule. Both Curtiss Electric and Hamilton-Standard dual-rotation propellers were available, but were considered only as temporary "stop gap" solutions to the problem at hand. Since the Hamilton-Standard propellers were further along in development, they became the ones chosen for Republic's airplane. However, it was at this early stage that the first considerations for using a single four-blade propeller on each engine began to emerge.

Although mechanically much simpler to operate than the dual-rotation design, the single propeller had disadvantages from a performance standpoint. Namely, the aircraft's top speed would be reduced by 5 mph, and its operating ceiling would be reduced by 3,000 feet. An interim solution of outfitting the first prototype with single propellers and then using the dual-rotation propellers on the second airplane was proposed. This was intended to accomplish two things: First, the aircraft's basic handling and performance could be tested and established without having to delay the first flight due to delays in propeller delivery, and second, this would allow Hamilton-Standard more time to identify and eliminate the inevitable "bugs" to be found in the dual-rotation system.

After almost another year of testing and development by both propeller manufacturers, it was determined that the supposed advantages of the highly complex dual-rotating system were simply not as beneficial as expected when compared to the single-propeller configuration. By July 1945, the USAAF Engineering Division at Wright Field determined that if Republic was awarded a production contract for the XF-12, dual-rotation propellers would not be available in sufficient quantities. It was this simple fact that caused the order for both XF-12 prototypes to be specified with single-rotation Aeroproducts propellers, and not the crash of the competing Hughes XF-11 with its dual-rotation propellers as has been speculated in the past.

The Photographic Airplane Receives its Designation

On the cover of this book, you notice that the Republic airplane is called the "XR-12" while the competing Hughes design is referred to as the "XF-11." To make matters even more confusing, the Republic airplane was originally designated as the "XF-12" on 4 February 1944, a date that was coincidentally two years to the day prior to the airplane's first flight. On 18 September 1947, the Army Air Forces officially became a new and separate branch of the U.S. Armed Forces called the United States Air Force, and by the summer of 1948, the Air Force had decided to modify and modernize its aircraft designations. The "P" for pursuit was changed to "F" for fighter and the "F" for photographic became "R" for reconnaissance. With the stroke of a pen, the XF-12 became the XR-12. Since the Hughes airplane was stricken from the military inventory in 1948, its designation was more popularly referred to as the pre–U.S. Air Force XF-11. The Republic airplane, however, was still flying as late as 1952; hence, the often-used reference to the later designation of XR-12.



Chief Designer Alex Kartveli (center) stands in front of the prototype XP-47B at Farmingdale in May 1941, flanked by Republic's operations director, C. Hart Miller (left), and Major Russell Keillor, Republic's Army Air Corps plant representative (right). The XP-47B was the third and final iteration of the experimental P-47 prototypes, and made its first flight on 6 May 1941, only seven months before the Japanese attack on Pearl Harbor. (Author Collection)

FROM SEVERSKY TO REPUBLIC

While the roots of the Republic Aviation Corporation date back to 1931 and the early years of the Great Depression, there is actually a small prelude to this story involving the home of its manufacturing facilities. Forever linked with mention of Republic is the city of Farmingdale, located in the flatlands of Long Island's south shore about 30 miles east of Manhattan's towering skyscrapers and 10 miles east of historic Roosevelt, Curtiss, and Mitchel Fields in the Hempstead Plains area. Situated well away from the more populated communities on the northern and southern shores of Long Island at the time, Farmingdale became home to a number of fledgling aircraft manufacturers as early as 1918—only 15 years after the Wright Brothers' first flight.

Modest Beginnings

Sperry has been a well-known name associated with aviation ever since Lawrence B. Sperry founded the Sperry Aircraft Company in 1916 to build aerial torpedoes for the U.S. Navy. The son of Elmer A. Sperry, famed inventor and developer of the modern gyrocompass for marine navigation, Lawrence established his airplane company and built a modest factory on the northern periphery of a large, flat plain north of the small town of Amityville. The first structure to be erected there, in what became a diminutive complex of manufacturing buildings, was home to a number of Sperry aircraft projects during and after World War I that included a tri-plane amphibian, a sleek monoplane racer, and a small general-purpose biplane built for the Army called the Messenger.

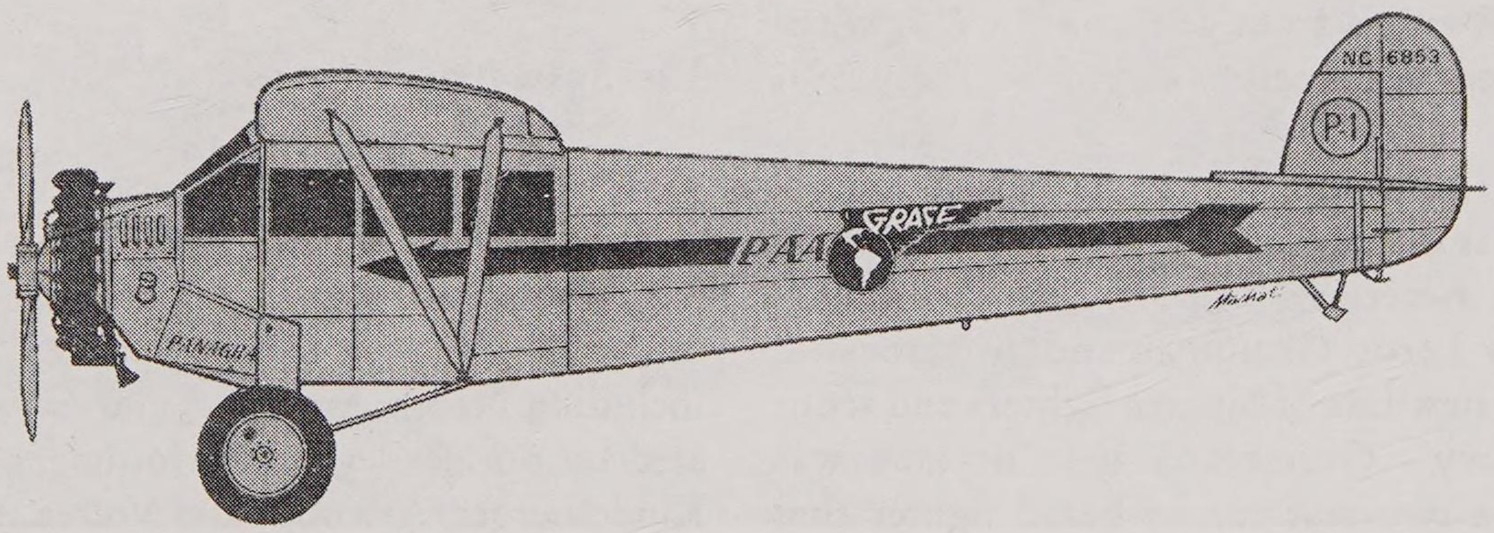
Lawrence Sperry also invented the three-axis gyroscopic system used for aircraft directional instruments and amassed nearly two-dozen patents for his aircraft-related inventions. Sadly, the firm was dissolved in 1923 after the unfortunate death of Sperry at age 31, when the Messenger he was flying was lost over the English Channel in bad weather. His small manufacturing facility was the precursor of a much larger site that eventually became home to the Republic Aviation Corporation, but there were several other well-known aircraft companies that would occupy this aeronautically prolific locale before Republic ever came into being.

In 1925, another aviation inventor and industrialist, Sherman Mills Fairchild, moved onto the former Sperry site and erected a large building to house a facility for building pontoons. Fairchild was the son of the founder of IBM, but was best known as the founder of a firm manufacturing highly advanced cameras used in airplanes for aerial surveying and mapping. His company eventually expanded to build its own airplanes, and what eventually became Republic's "Building No. 5" was constructed in 1926 on the northern border of what was now a small informal grass-surface flying field. Fairchild's first airplane was the pioneering FC-1, powered by a Wright Whirlwind engine, and used as an aerial photography platform. A larger and more powerful follow-on design was built in 1928, and soon captured the attention of several fledgling airlines, one of which was a new small company called Pan American Airways. Its president, Juan T. Trippe, ordered four of the four-seat FC-2W2 passenger versions of Fairchild's little 100-mph monoplane for his Pan American Grace division serving cities in South America from Miami.

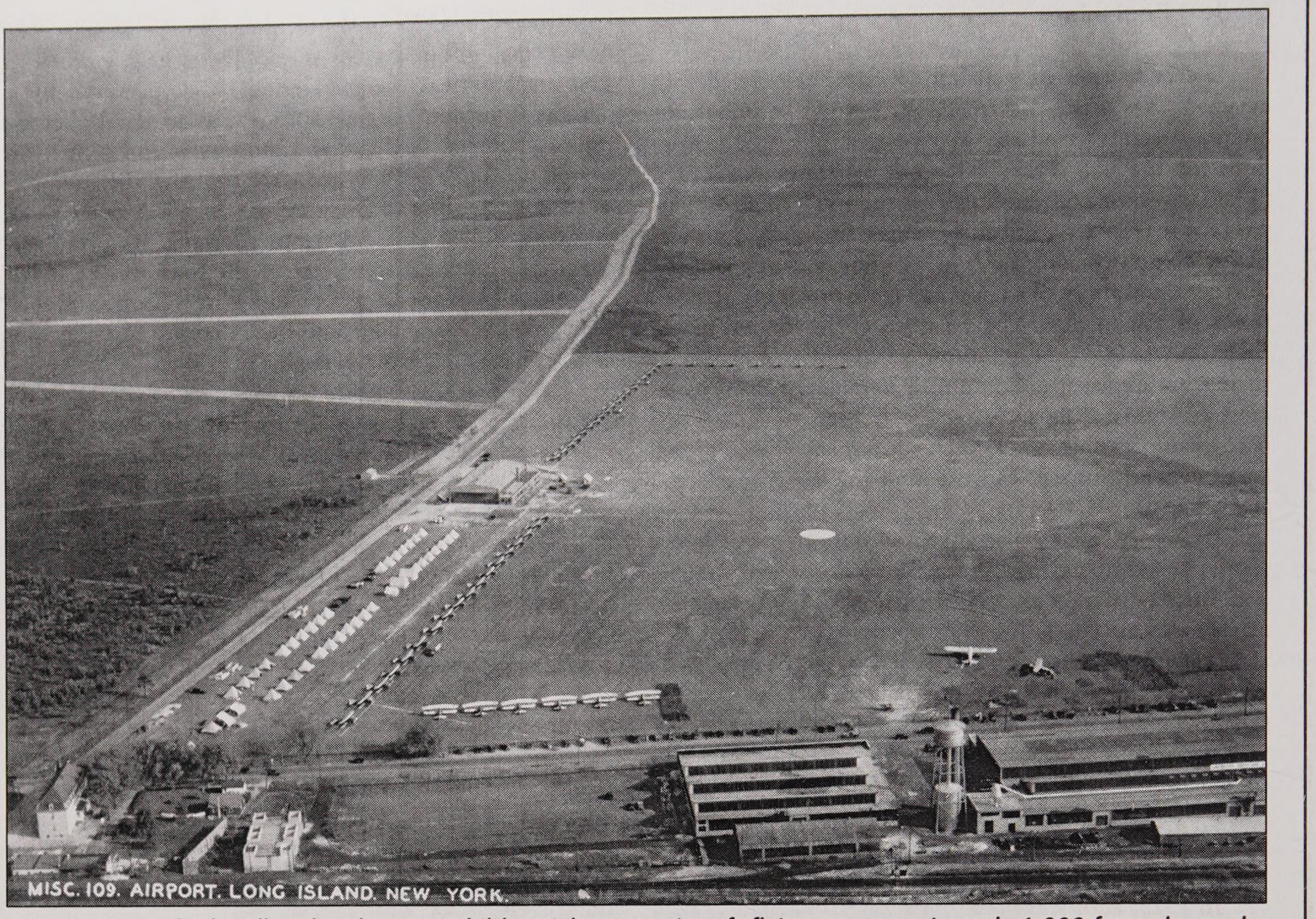
Requiring ample space for flying its newly manufactured aircraft, The Fairchild Company purchased a 100-acre parcel of flatland immediately south of the plant that had been developed into Fairchild Flying Field, which formally opened in July 1928. A new hangar was also built on the eastern periphery of the field, and a new boundary road was constructed and named, quite appropriately, New Highway.

With the success of the FC-2 series, Fairchild became a well-recognized name in aircraft manufacturing, and by early 1930, the company had become the world's largest builder of enclosed-cabin monoplanes. Use of a Fairchild FC-2W named *Stars & Stripes* for Admiral Byrd's successful Antarctic Expedition garnered further worldwide attention for the company, and its larger and improved six-passenger Model 71 became an instant hit with airlines, and bush pilots expanding the frontiers of the frozen north.

By late 1930, Fairchild's manufacturing facilities were comprised of nine buildings, and Fairchild Flying Field featured two 4,000-foot-long grass runways running northwest to southeast and northeast to southwest. However, growing production demands began to require even more space, and Fairchild eventually relocated to a larger facility at Hagerstown, Maryland. Occupying part of the remaining Farmingdale site was a Fairchild



The small but reliable Fairchild FC-2 was the first airplane produced in quantity at Farmingdale. A successor to the FC-1 prototype aerial photo platform, the production FC-2 entered commercial airline service in May 1929 with a new airline based in Miami called Pan American Airways. The little six-seat airplane served under the Pan American Grace banner on routes throughout South America. Later versions were powered by 450-hp Pratt & Whitney Wasp engines, and cruised at a speed of 100 mph over routes of up to 700 miles long. (Mike Machat)



This photo, undoubtedly taken by a Fairchild aerial survey aircraft flying at approximately 1,000 feet, shows the Fairchild Flying Field in early 1928. Building 5 is at lower right, with New Highway running diagonally across the photograph. View is looking south with an Army encampment occupying the northeast corner of the field at lower left. What became Republic's Hangar 1 is located midway up New Highway, and is today adjacent to Hangar 2, home of the American Airpower Museum. (Frank Strnad via Author Collection)

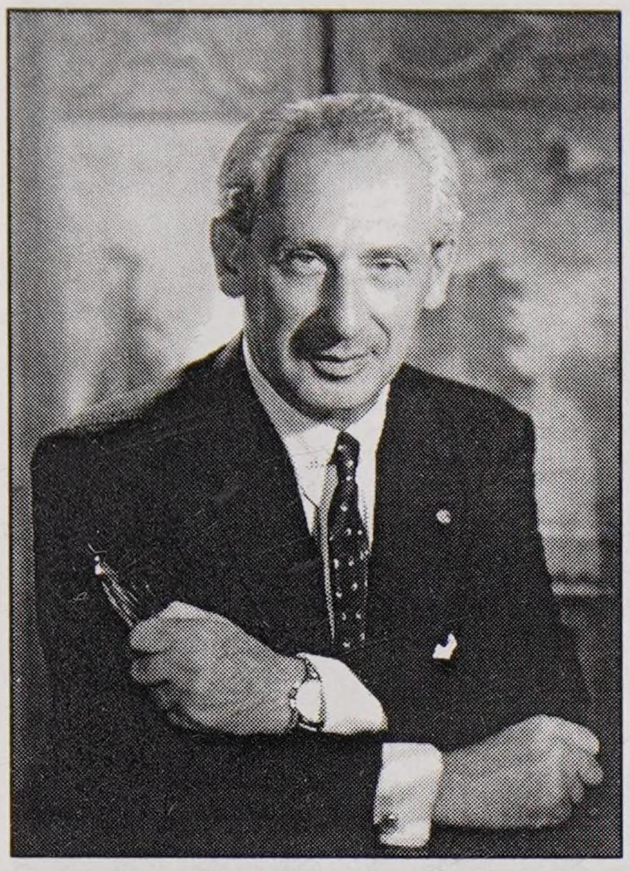
subsidiary named American Airplane & Engine Corporation (AAE). AAE used the plant to build a rather bulky looking single-engine high-wing passenger and cargo transport for American Airlines called the Pilgrim. Production lasted from 1930 until 1932, when the company folded as another victim of the Great Depression.

The next name in this impressive procession of aviation manufacturers is one still in use today. With the airfield now renamed American Airport, a new company founded in 1930 by Leroy Grumman and his associates moved in to build a new line of biplane fighters and scout aircraft for the Navy. Grumman's first airplane was called the XFF-1, a two-seat carrier-based fighter that sired an entire family of legendary Grumman naval aircraft; 60 production model FF-1s were built at Grumman's new Farmingdale facility from 1931 to 1933. By 1935, subsequent Farmingdale-built Grumman aircraft included the XJF-1 floatplane, F2F-1 single-seat biplane fighter, JSF-1 Duck, and F3F-1, the company's last biplane fighter, which was also used as a racing airplane named the Gulfhawk, and flown by famed racing pilot Al Williams. In 1937, the rapidly expanding Grumman plant was relocated 5 miles to the west in the suburban town of Bethpage.

The Seversky Era

Their names are legendary: Douglas, Northrop, Lockheed, Grumman, Vought, Bell, Curtiss, Martin, McDonnell—all once-great American aircraft companies founded by the great men who bore their names. Others, including North American and Consolidated, were created by no-less-legendary founders with names such as Kindelberger, Atwood, and Vultee. When it came to the Republic Aviation Corporation, however, the founder's name had only one thing in common with that of the company's—the number of letters on the factory signs!

Major Alexander P. de Seversky was best known as a pilot and Russian Count. However, this brilliant entrepreneurial industrialist was also a pilot who fiercely believed in the positive aspects of aviation for both

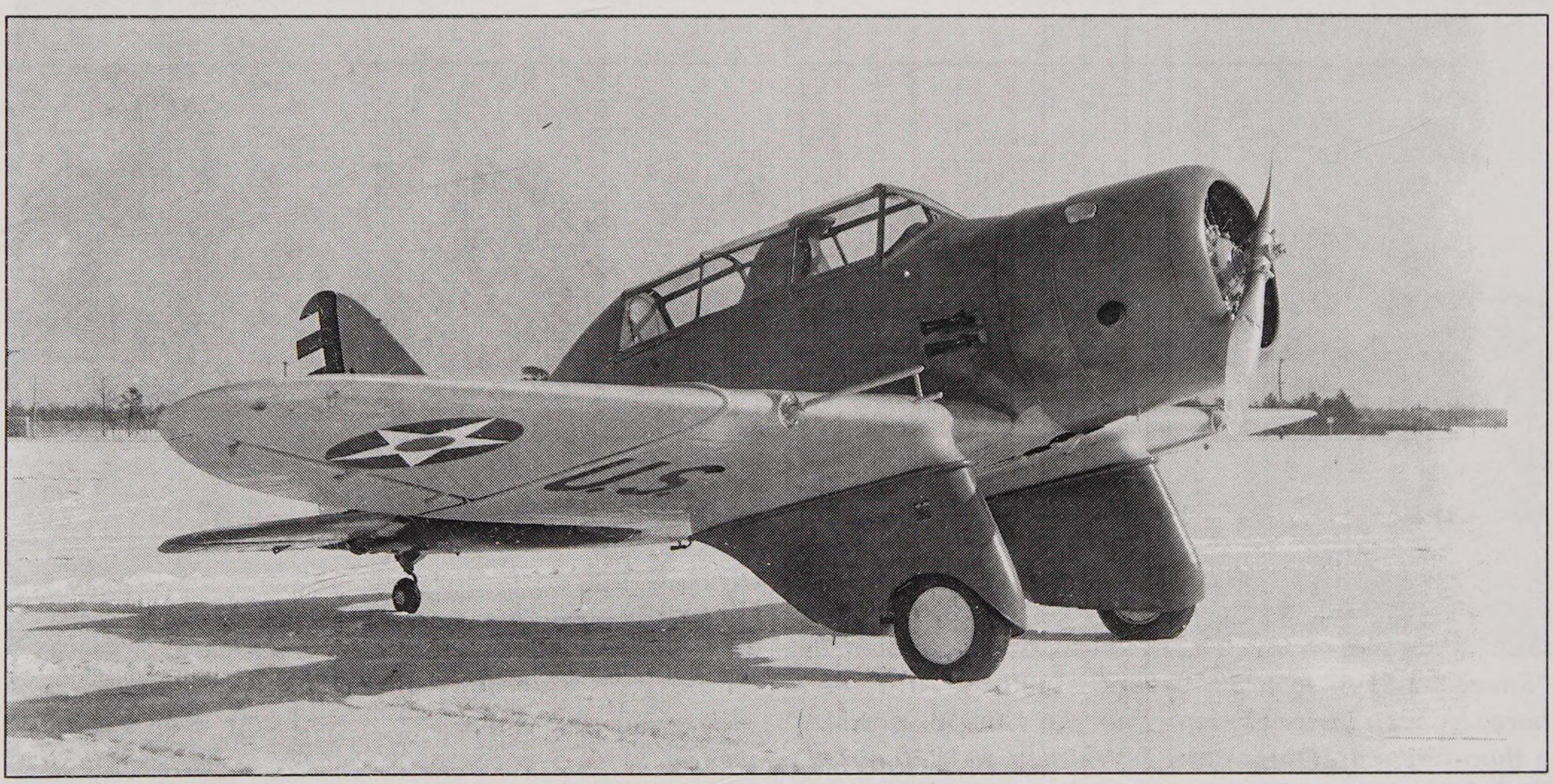


The man who started it all, Count Alexander P. de Seversky, is pictured here in the early 1940s after he had left the proud company bearing his name. His elegant persona and radiant charm captivated all who knew him, although his industrial acumen stemmed from an earlier era and ultimately created problems for Seversky that affected his company's performance and future. (Cradle of Aviation Museum Archive)

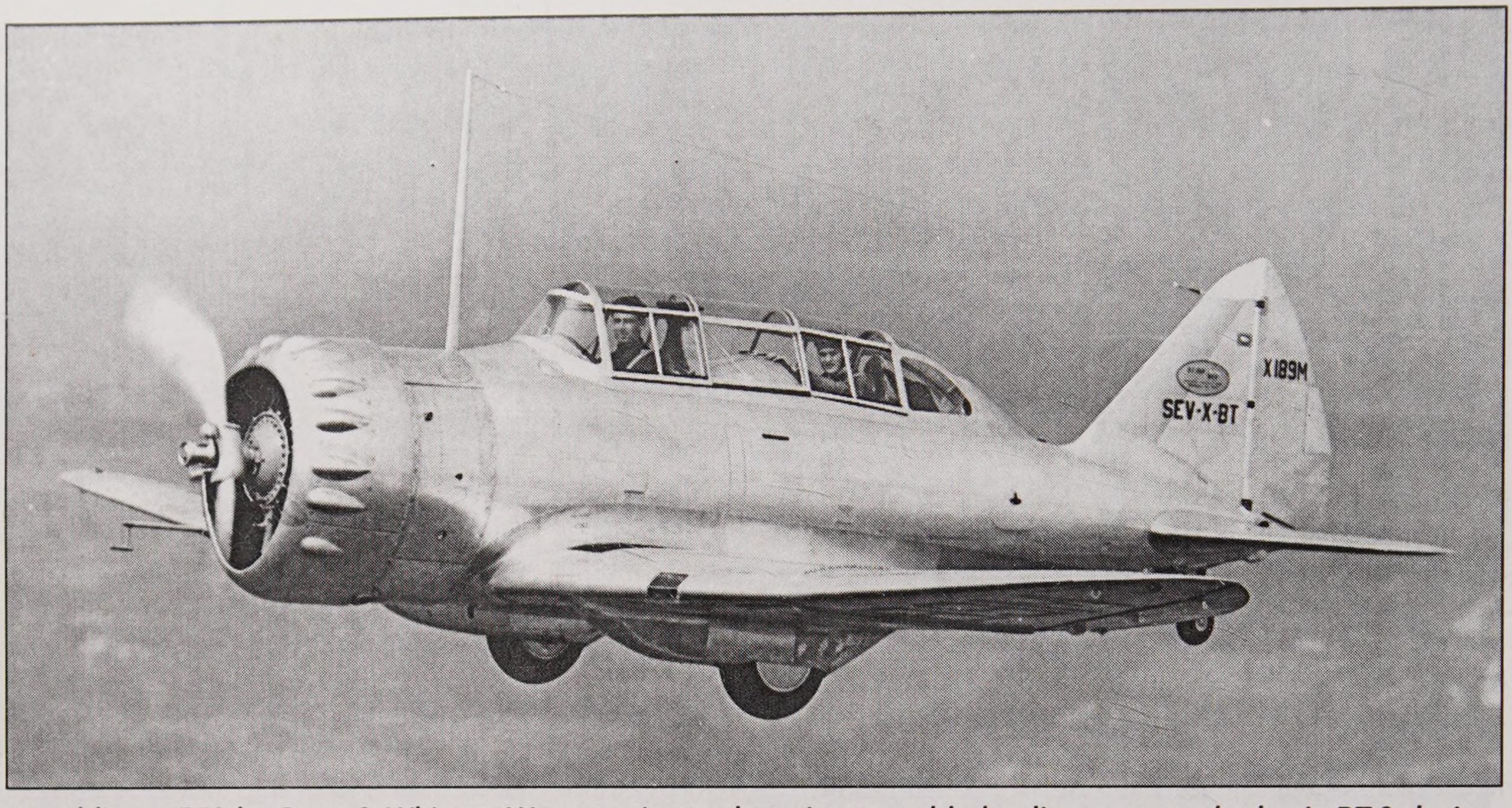
military and civil applications, and his contributions to American aviation in the years leading up to World War II were nothing less than remarkable. Seversky is credited with designing the world's first fully automatic bombsight, the world's fastest amphibious airplane, and the first low-wing basic training airplane ever used by the U.S. Army Air Corps. He also pioneered high-altitude aerial combat tactics by designing and building the first turbo-supercharged pursuit fighter equipped with an air-cooled engine.

Born in Russia in 1894, Seversky attended military school as a boy, and graduated as a lieutenant from the Russian Naval Academy at the age of 20. He acquired graduate degrees in mechanical and aeronautical engineering, and was chosen for flight training the following year. Seversky quickly distinguished himself piloting both pursuit and bomber aircraft, and after shooting down 13 enemy airplanes in World War I action, he became Russia's highest-scoring Ace in 1917. He came to the United States in 1918 as a member of the Russian Aviation Mission, and was appointed aeronautical engineer and test pilot. Assigned as an advisor to General Billy Mitchell in 1921, Seversky continued to advance rapidly in military aviation and, upon winning his U.S. citizenship in 1927, was awarded the rank of Major in the U.S. Army Air Corps Reserve.

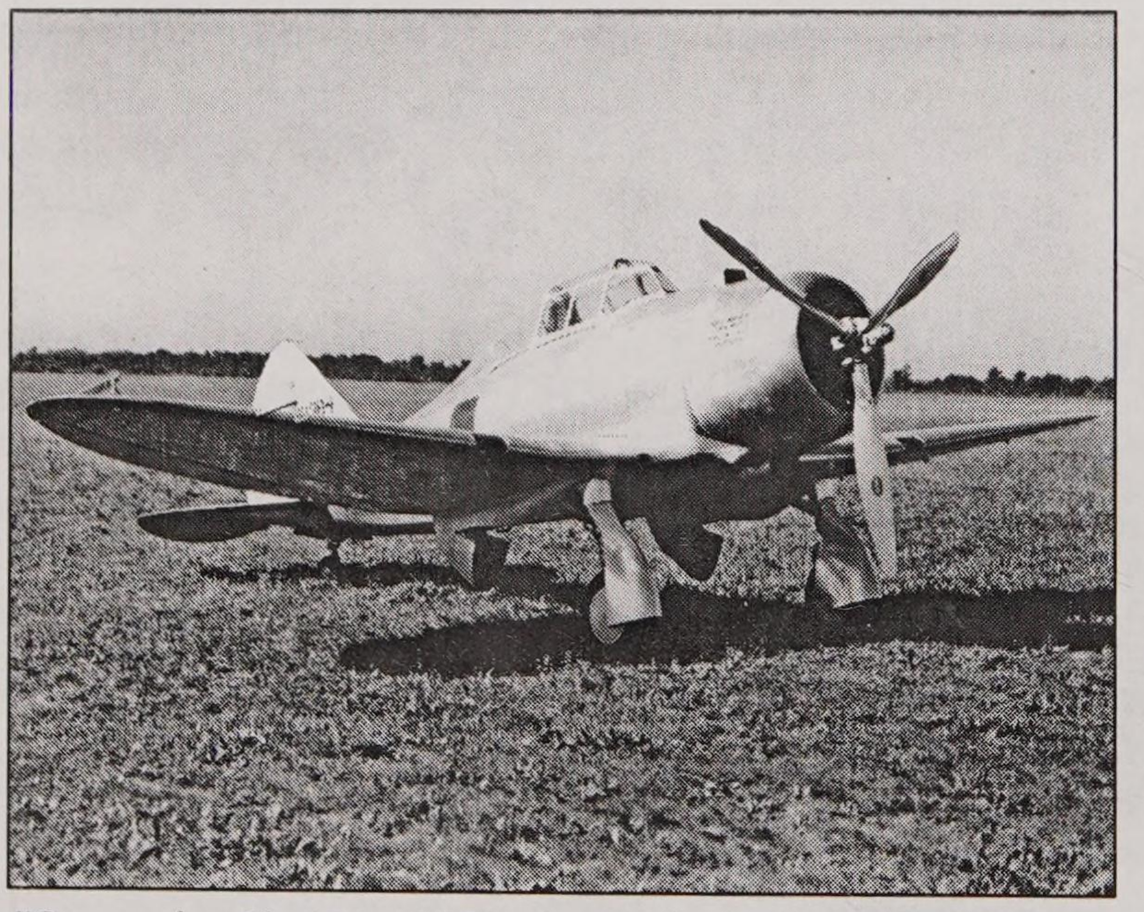
With financial backing from a consortium of Wall Street bankers, he founded the Seversky Aviation Corporation in February 1931, and moved the company's engineering and manufacturing operations to Farmingdale's American Airport, buying the former Fairchild facility and airfield in late 1934. In 1935, a company called Ranger Aircraft occupied the smaller building in the complex, but by 1936, Seversky was building two different types of aircraft for two very different



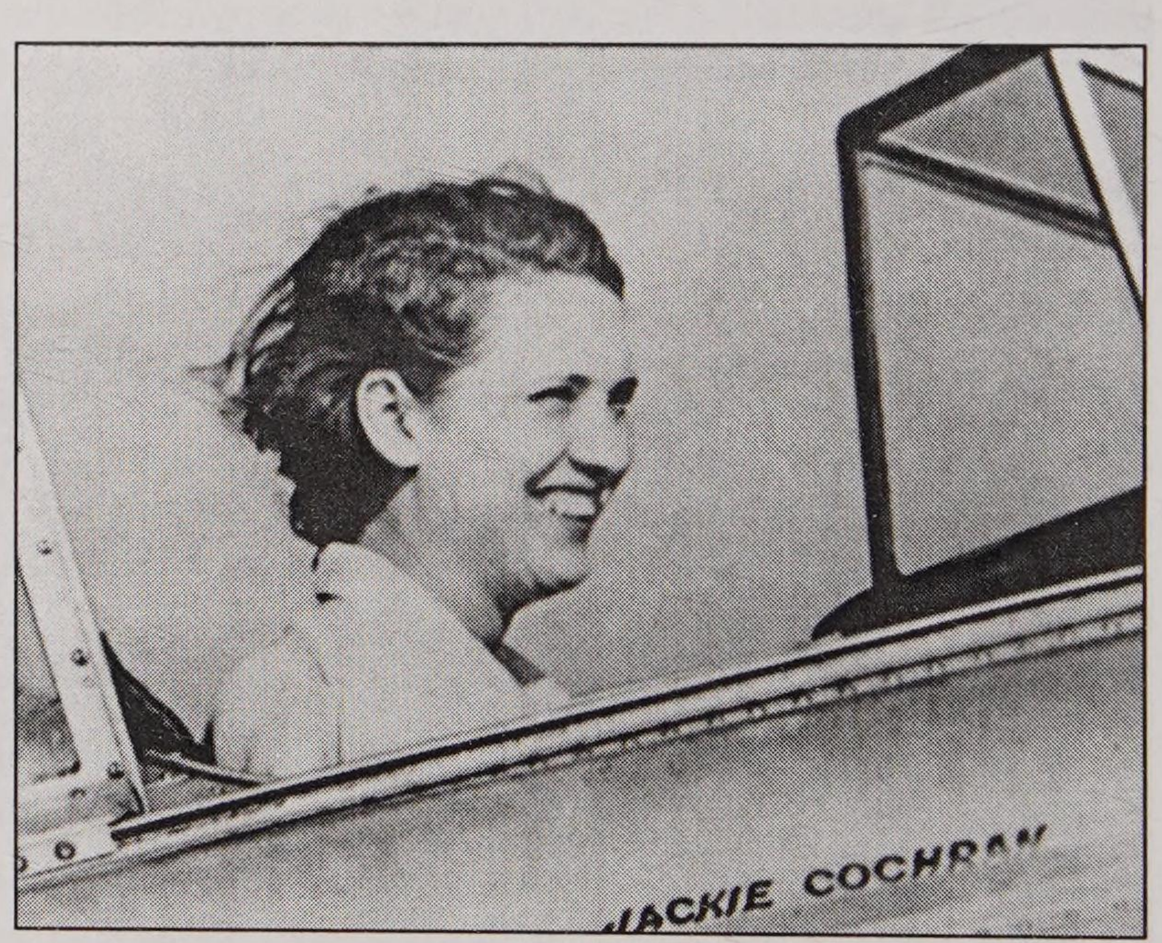
After building and flying numerous one-of-a-kind prototypes of fast pursuit aircraft and record-setting racing planes, Seversky won the Army's Basic Trainer Competition in 1935 and landed its first government contract to build 30 BT-8 basic trainers. Powered by a 400-hp Pratt & Whitney R-985 engine, the BT-8 was the Army's first low-wing, enclosed-cockpit trainer. Although somewhat underpowered, but with pleasant handling characteristics and a top speed of 175 mph, the little two-seaters were quite popular at Army training bases, and the name Seversky became well established nationwide as a builder of rugged and reliable aircraft. (Wings & Airpower Historical Archives via Author Collection)



By adding a 550-hp Pratt & Whitney Wasp engine and semi-retractable landing gear to the basic BT-8 design, Seversky was able to create the XBT which was then entered into another Army competition for an advanced training aircraft. That competition was won by North American Aviation with a similar-looking aircraft called the BT-9, progenitor of the legendary AT-6 Texan of World War II fame. The loss of that competition caused Major Seversky (shown flying the XBT in this photo) to seek military orders from other countries, setting a new course for the company. Note the high-performance engine cowling, exceedingly tall radio antenna mast forward of the windshield, non-retractable tailwheel, and novel one-piece windscreen. (Wings & Airpower Historical Archives via Author Collection)



"Sever-the-Sky!" In 1938, Seversky built the AP-7 seen here, an even faster airplane than the 1XP, powered by a thundering 1,200-hp Pratt & Whitney R-1830 radial. With lucky race number "13" emblazoned on the sides of the airplane, aviatrix Jackie Cochran gained notoriety by flying from Burbank, California, to Cleveland, Ohio, in little more than eight hours at an average speed of 249.7 mph, and winning the 1938 Bendix Trophy in the process. (Wings & Airpower Historical Archives via Author Collection)



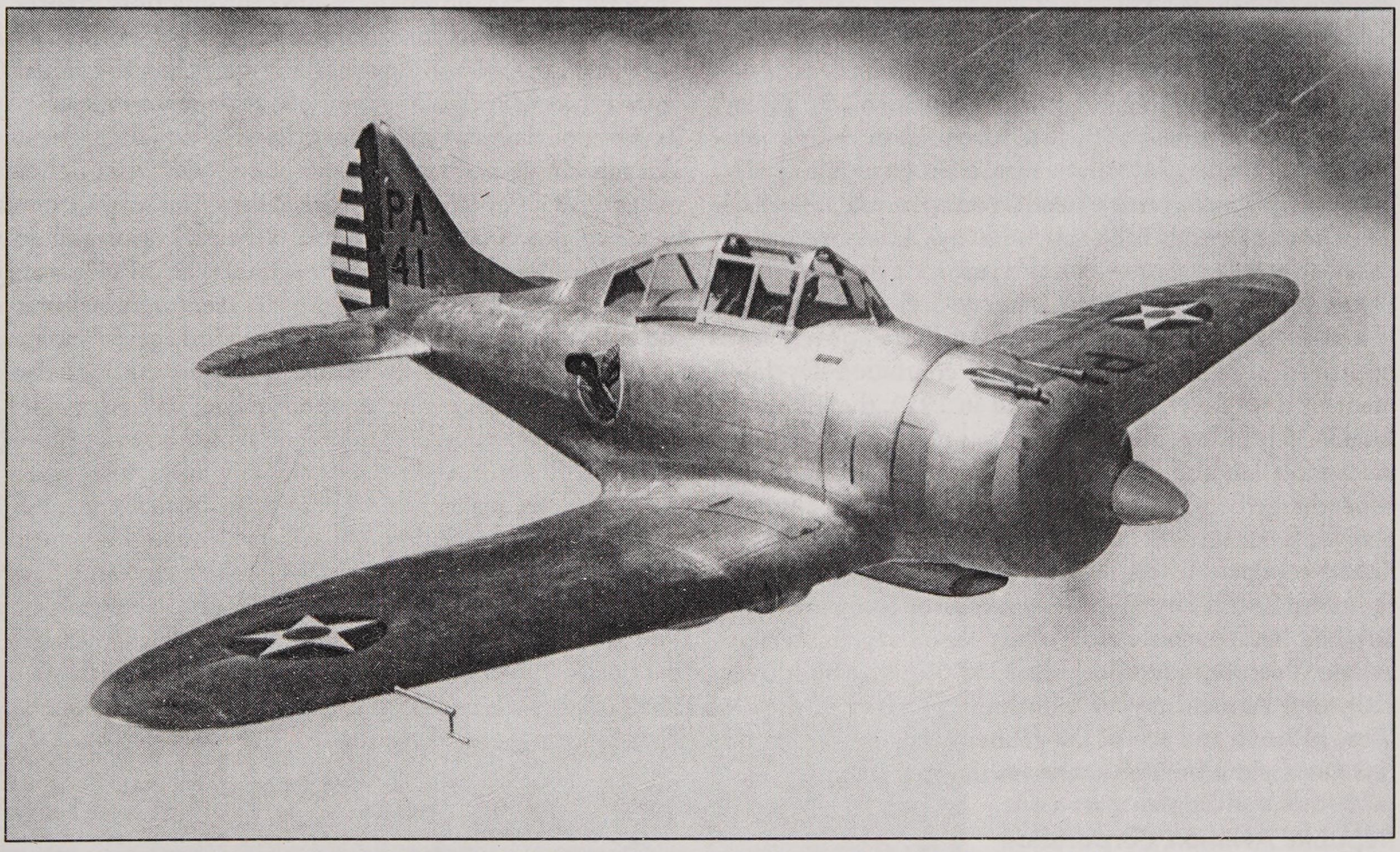
Addressing assertions from the War Department expressing displeasure that a corporate chief executive was flying his own company's airplanes and setting publicity-grabbing records in the process, Seversky invited a young unknown aviatrix to fly his 1XP racer. Jacqueline Cochran, seen here in the cockpit of the Seversky racer, quickly rose to the task by setting several women's speed records, and taking the racing world by storm. She became a co-founder of the Women Airforce Service Pilots (WASPs) of World War II. (Author Collection)

types of missions. One was a float-equipped two-seat amphibious racing airplane called the SEV-3; the other was a low-wing training monoplane for the Army Air Corps called the BT-8. Seversky himself was at the controls of an SEV-3 in 1935 when that airplane set a world speed record of 230 mph at Roosevelt Field, site of Lindbergh's takeoff for his epic transatlantic solo flight only eight years earlier.

An entire series of sleek, powerful Seversky aircraft was built in the mid 1930s, with one distinctive design emerging as the stalwart P-35 pursuit fighter. Fitted with improved configurations for retractable landing gear, sleeker cockpit canopies, and ever more powerful radial engines, these new aircraft were equipped with similar graceful-looking, elliptical wings. This distinctive wing shape eventually became a well-known Seversky trademark. Famed aviatrix Jackie Cochran set a woman's speed record of 300 mph in a civilian version of the P-35 called the AP-7, and won the 1938 Bendix Trophy Race as well. Other famous pilots who flew Seversky racers include Frank Fuller and Jimmy Doolittle. With contemporary military pursuit aircraft capable of flying at 180-mph, the superior performance of Seversky's airplanes gained national attention.

The aeronautical engineer behind the design of the elliptical Seversky wing, and all the other distinctive aerodynamic features of these aircraft, was yet another Russian-born émigré named Alexander Kartveli who arrived in the United States via Paris in 1927. Persuaded to come to America with his good friend, French aeronautical designer Armand J. Thieblot, Kartveli was hired by Seversky in 1931, starting as an assistant engineer. Thieblot became chief engineer for Fairchild in Hagerstown, Maryland, while Kartveli soon rose through the ranks to become Seversky's chief engineer and the key person responsible for establishing the company's reputation for designing and building rugged and robust, yet exceedingly fast single-engine racers and pursuit aircraft. Later, as vice president of engineering, Kartveli left his imprint on every single tactical aircraft built by Seversky's successor company, the Republic Aviation Corporation.

Although the P-35 became Seversky's first successful military-pursuit airplane produced in quantity for the U.S. Army Air Corps (and later also exported to Sweden as the EP-1), the physical process of transitioning from the construction of single hand-built prototypes to establishing a full production line for 77 new aircraft began to create workflow and assembly-sequence problems in the Farmingdale plant. Developing effective and efficient manufacturing techniques while complying with rigid government regulations proved to be a



The P-35, manufactured in 1936 and 1937, was Seversky's first military fighter and the company's most successful production aircraft for the U.S. Army Air Corps. It was armed with two machine guns mounted on top of the engine cowling (one .50 caliber and one .30 caliber), and is shown here with added modifications of a propeller spinner and small dorsal fin. The P-35 had a top speed of 281 mph. (Wings & Airpower Historical Archives via Author Collection)

formidable challenge, and production delays began to mount, causing increasing financial hardship for Seversky. This situation was further exacerbated by internal company management problems and concurrent development of additional new prototype aircraft designs such as the AP-9.

A long-range, two-place scout-bomber version of the P-35, called the 2PA, was built in 1937 and was proposed to the Army Air Corps, but rejected in favor of other designs from competing manufacturers. Undaunted, Seversky actively sought and obtained orders from the air arms of two overseas countries, and 22 2PAs were built and exported to Japan and Seversky's homeland, Russia. As beneficial as this may have been financially for the company's coffers, it was a move that was highly disdained by the U.S. government, for Japan was starting to be considered as a potentially hostile adversary. With this one bold, yet risky move, Seversky and his airplane manufacturing company fell out of favor with the U.S. Army Air Corps, and expected subsequent orders for new and improved Seversky fighters were slow in coming.

By late 1938, Seversky's Board of Directors was becoming increasingly dismayed and impatient. They began opposing his spending excessive amounts of company time and money on flamboyant publicity stunts and one-of-a-kind experimental prototypes, rather than on development of more financially lucrative production airplanes. With his company now mired in more than $1 million of debt (a huge sum in the midst of the Great Depression) incurred with P-35 production delays, and having made the politically incorrect move of selling airplanes to Japan, Seversky faced a rather formidable challenge for the survival of his company. After producing only 140 aircraft, the Seversky Aviation Corporation was teetering on the brink of bankruptcy.

Still attempting to capture military orders for improved pursuit aircraft, Seversky continued development of new aircraft designs, and in 1939, the 77th and final P-35 off the production line was modified with fully retractable landing gear, a revised cockpit canopy, and a supercharged engine. Designated the XP-41, this airplane evolved even further, and its lines became unmistakably linked to those of an even larger, faster, single-engine fighter to be built by Seversky's successor company. That airplane became one of the most legendary fighters in aviation history, with more than 15,000 being built over six years. A mainstay of U.S. military aviation during World War II, and one of the greatest aircraft ever flown, this new fighter became known as the P-47 Thunderbolt.

Republic Aviation Corporation

In late 1939, with Seversky out of the country on a promotional tour seeking more aircraft orders in Europe, the Seversky Board of Directors felt compelled to make a strategic decision of major importance in his absence. On 12 October, with the full intent of saving their beloved company, the Board voted Alexander P. de Seversky out of office. Soon thereafter, a major financial reorganization was enacted, including the issuance of nearly $1 million of common stock. A new name was chosen for the company as well, with the Board stipulating that the name had to meet two requirements. First, it had to have the same number of letters as the word "Seversky" to be adaptable to all the company signage, and second, it had to be a patriotic name reflecting great nationalistic pride. The eight-letter word Republic was chosen, and the Republic Aviation Corporation was born.

Under the guidance of its new president, W. Wallace Kellett, the newly reorganized organization began to regain its financial health. Kellett, former head of the autogiro firm of the same name, immediately restructured the company's workforce by laying-off more than half its 500 employees, and actively sought new aircraft contracts, securing a major order to build P-35s for Sweden. The reorganization resulted in not only saving the company, but in establishing profitability less than one year from the ousting of Seversky.

Republic was back in the good graces of the Army Air Corps and development contracts began to flow out of Washington once again. A derivation of the XP-41, named the XP-43, underwent development and showed promise as the company's next production fighter. Named the Lancer, this aircraft was the first to be officially considered a Republic-built airplane. Equipped with a turbo-supercharger to boost the power output of its air-cooled Pratt & Whitney R-1830 radial engine at altitude, the Lancer also became the world's first fighter to exceed 350 mph in level flight. Army Air Corps orders began to flow in and the company started to resume its former production momentum. A total of 272 P-43s were built, and 108 ex-Army Air Corps Lancers were acquired for use by the Chinese Air Force in action against Japan.

As for the original company's founder, although disappointed at the outcome of events in late 1939, Alexander de Seversky was busier than ever. Having served as president and director of his company for more than seven years until his ouster, he sought to make further contributions to military aviation and still held numerous world speed records as a pilot. In 1940, Major Seversky was awarded the prestigious Harmon Trophy by President Franklin D. Roosevelt for his numerous achievements in the field of aviation, and in 1942, he published his famed book *Victory Through Airpower,* which was subsequently made into an animated feature film by Walt Disney.

Bolts of Thunder

Much has been written over the past 65 years about the P-47 Thunderbolt, and although the detailed story of this airplane is beyond the scope of this book, its development was not untypical of most aircraft programs during the tumultuous year of 1939. With the imminence of

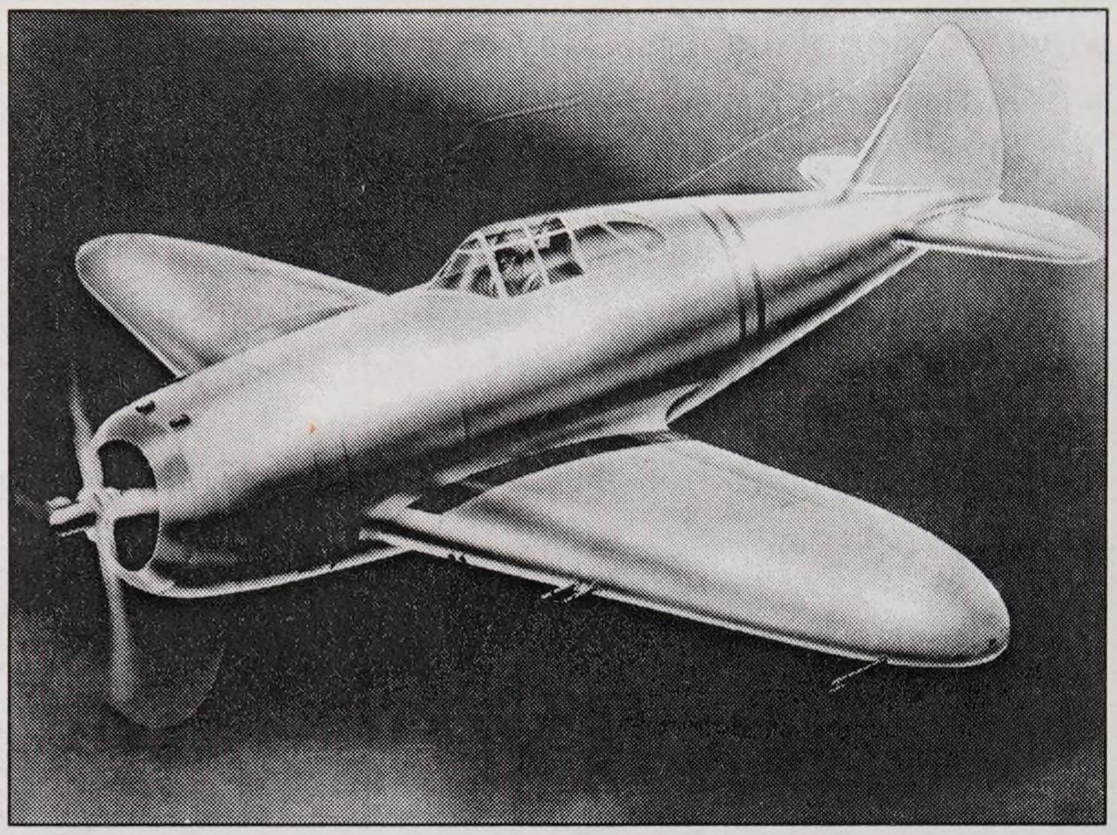
America's involvement in World War II, new advanced aircraft of all types were in strong demand by the War Department. Chief designer Kartveli's dedicated engineering team rose to the task by developing proposals for various lightweight, single-engine pursuit aircraft. What emerged from the many design studies and government reviews for the planned but stillborn XP-47 and XP-47A fighter projects was a larger, heavier airplane powered by Pratt & Whitney's newest engine—the mighty 2,000-hp R-2800 Double Wasp radial.

Designed for superior high-altitude performance and armed with eight .50-caliber machine guns, this new airplane boasted a top speed of more than 400 mph in level flight. Named the XP-47B, it served as the perfect complement to other new U.S. fighter designs such as the lighter North American P-51 Mustang and Lockheed's twin-engine P-38 Lightning. With its 35-foot length, 41-foot wingspan, and 12,000-pound gross weight, the XP-47B was the largest and heaviest single-engine fighter aircraft built in the United States, and became the progenitor of what evolved into Republic's legendary family of Thunderbolt fighters. First flight of the XP-47B with test pilot Lowery Brabham at the controls took place on 6 May 1941, and the first production P-47Bs starting rolling out of Republic's final assembly building to enter operational service one year later.

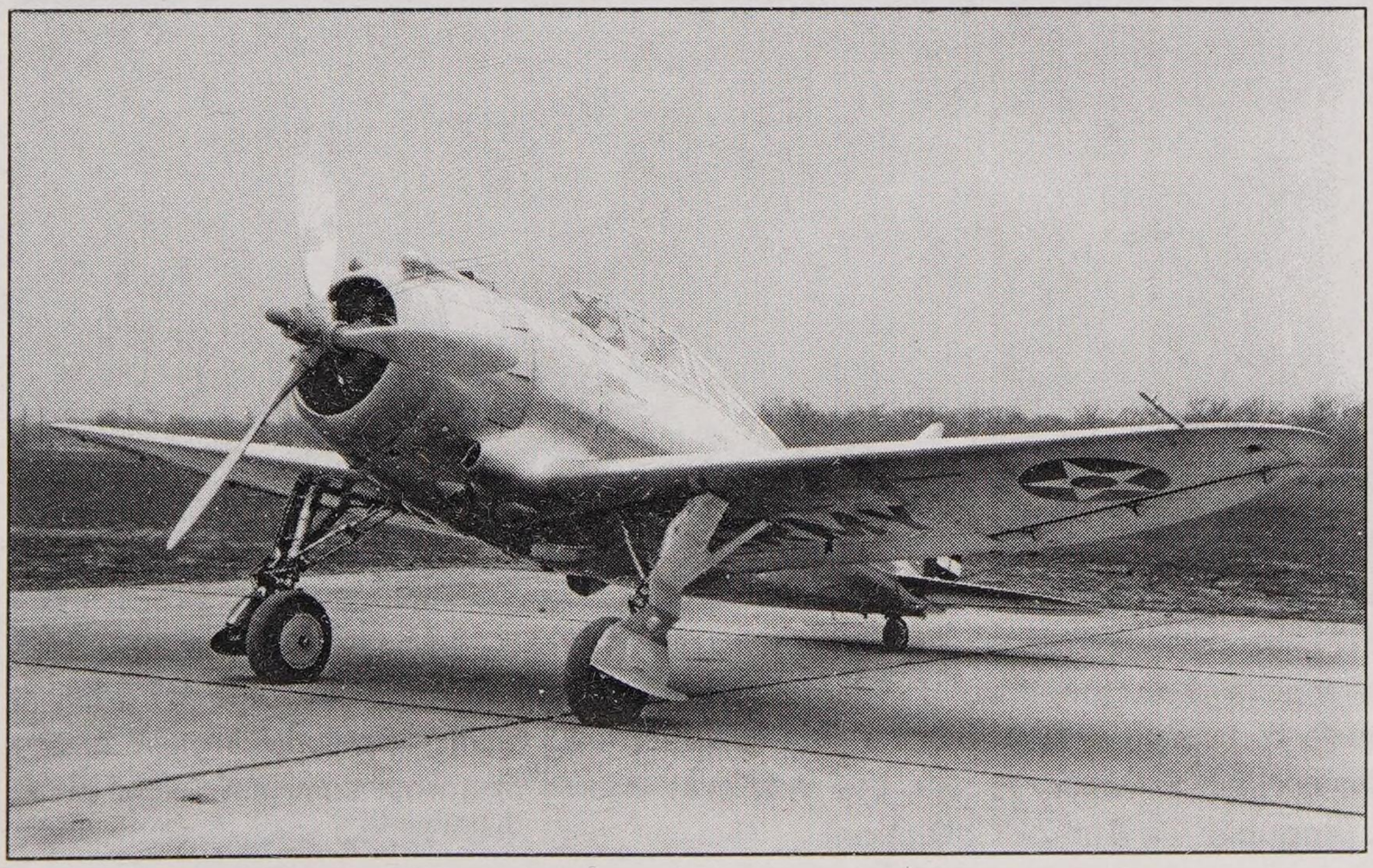
By 1942, with the United States now fully involved in both the European and Japanese theaters of World War II, demand for the P-47 was at an all-time high, and production rates ramped up accordingly. To meet those demands, Republic sought to further expand its manufacturing facilities with the construction of Hangar 2, also adjacent to New Highway. In early 1943, construction began on the multi-faceted Building 29 complex on the facility's west side, with its main center section reserved for subassembly fabrication. Subsequent outer sections of this building facilitated further parts and subassembly manufacturing in the following months.

Construction of Building 29E (east) and Building 29S (south) was completed in March and June 1943, respectively, while Building 17 on the eastern flank of the plant became the largest open-bay building in the complex, serving as the vast final assembly area of the production line. This is where all the many aircraft subassemblies manufactured in the Building 29 complex were moved, positioned, and then fitted together to become finished P-47 Thunderbolts, nearly 10,000 of which were built in that facility.

Further improvements to the original P-47 design created the heavier, longer-range P-47C, which saw combat



A further development of the XP-41 was the smaller, lighter, and more powerful XP-44, but this concept was never built, as P-43 production ramped up instead. Although the lines and proportions were quite similar to the airplane that became the P-47, close examination of the size of the pilot figure in the cockpit reveals this to be a much smaller aircraft. Note machine guns in both the engine cowling and wing leading edges. (Wings & Airpower Historical Archives via Author Collection)



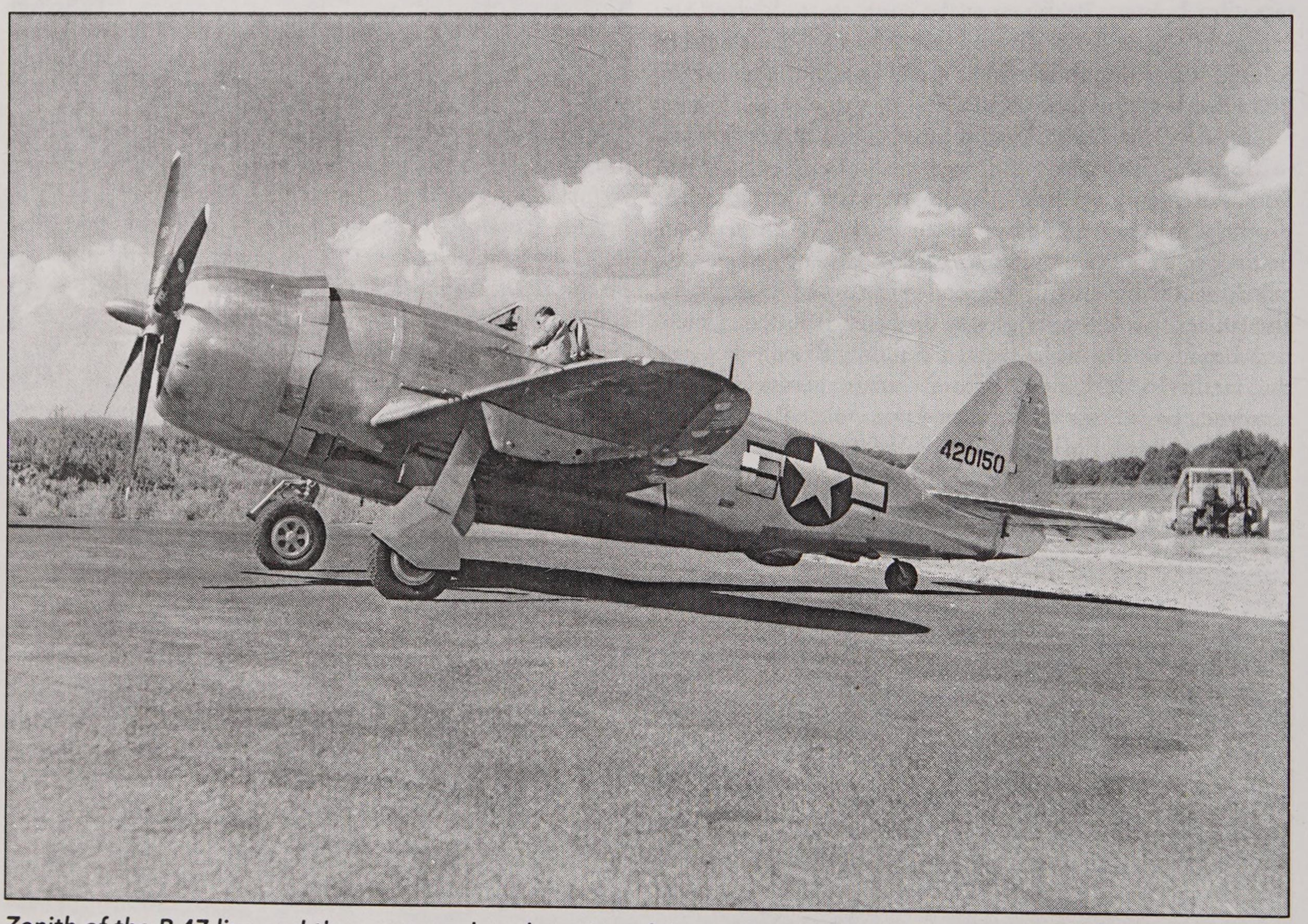
The 77th and final P-35 to come off the Seversky assembly line was modified into the XP-41 seen here at Wright Field in Dayton, Ohio. This aircraft further evolved into the XP-43, which became the production P-43 Lancer, built by the newly established Republic Aviation Corporation in 1940. The P-43 was the world's first airplane to exceed 350 mph in level flight. (Wings & Airpower Historical Archives via Author Collection)

action in Europe. The P-47D, the most famous model of the Thunderbolt series, also became the most-produced P-47 variant, with production rates peaking at almost one airplane rolling out the door every hour. It entered service in early 1943 as one of the Army Air Force's primary long-range escort fighters for B-17s and B-24s flying critical strategic bombing missions over Germany. Later versions of the P-47D were fitted with a new bubble canopy that allowed pilots the full 360-degree visibility so critical in dogfights with enemy aircraft. More than 800 of these, called the Thunderbolt Mark II, also served with the Royal Air Force. The final P-47 production model was the even longer range P-47N, with revised squared wingtips, dorsal fin, and heavier payload. P-47Ns saw action in the Pacific through the end of the war.

The P-47 program doesn't just represent the financial pinnacle of Republic's business history, but also has to be considered one of the company's most successful programs. Despite the overall earnings of Republic being anywhere from one-third to one-half those of larger competitors such as Douglas, Lockheed, or North American during World War II, total P-47 production generated gross sales of $905 million, with a net profit of $11 million. Despite the company producing a total of nearly 9,000 jet fighters in the following two decades, there was never a program that generated as much net return as the P-47 Thunderbolt.

Drawdown of P-47 Production

With the announcement of V-J Day (Victory in Japan) on 14 August 1945, the tide of wartime production in the United States came to a grinding halt. After producing a total of 15,683 P-47 Thunderbolts (6,242 of which were built at Republic's Evansville, Indiana, plant), Republic imposed a ten-day shutdown of both plants and immediately laid-off more than 50 percent of its total workforce. Along with the massive layoffs came the cancellation of orders for nearly 6,000 P-47Ns, and the very last P-47 to be built rolled out of Building 17 on 9 November 1945. Remaining surplus P-47s were then sold off to foreign nations with a large number going to the air arms of Latin American countries where they served well into the 1960s. It is also interesting to note that of the

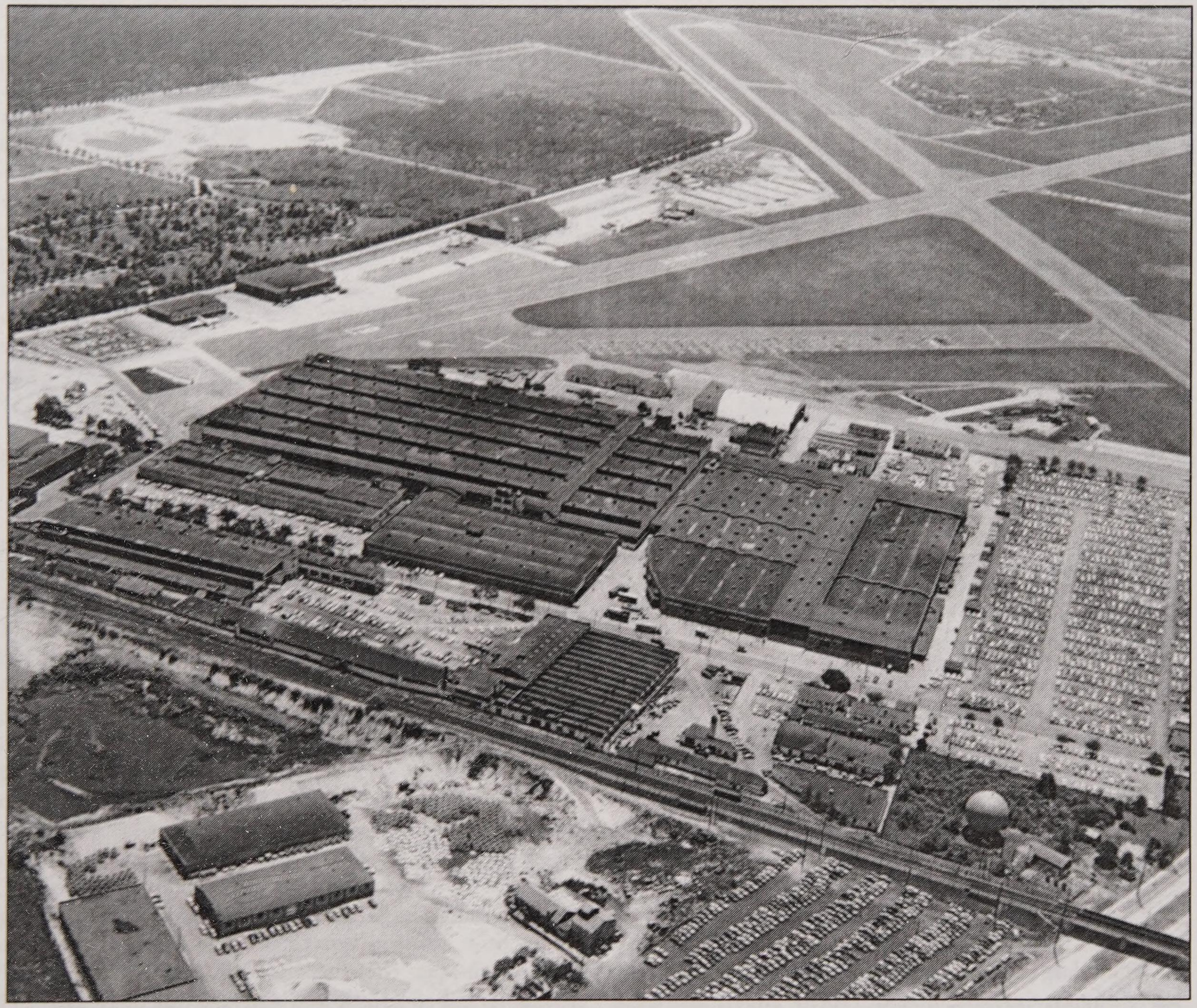


Zenith of the P-47 line and the most produced version of the series was the P-47D, seen here with the new 360-degree-view bubble canopy. This aircraft, a factory-fresh P-47D-28-RE devoid of any military unit insignia, is parked on a new asphalt staging ramp just south of Republic's main manufacturing facility. Epitomizing the entire line of airplanes stemming from the earliest Seversky racers, the P-47 was one of the most successful and most produced aircraft of World War II. (Republic via Author Collection)

nearly 16,000 P-47s built, approximately 3,500, or one-third of the entire production run, was lost in the war.

What followed next for the company served as both a financial "lifeboat" to sustain business, and a sobering harbinger of things to come. After producing only single-engine military fighters and racing airplanes since its inception, Republic accepted an $11 million civilian contract from American Airlines to convert surplus Douglas C-54 Skymasters into DC-4 passenger airliners for the emerging postwar commercial airline market. Modifications to these four-engine military transports included the fabrication of a 44-seat passenger interior with a lavatory and galley, and elimination of the C-54's large clamshell cargo door. Replacing that was a smaller, single passenger-loading door, and the modification of a small crew entry door on the right forward fuselage enlarged as another passenger-loading door. This became an American Airlines feature later carried over to its twin-engine Convair 240s.

The C-54 conversion program began in September 1945 and ran through late 1946. Although this contract did indeed provide employment and financial sustenance for Republic at a very critical time in its history, it also represented an economic trend that would spell disaster for a new airplane the company was hoping to develop as a world-class airliner.



Although this aerial view of the Republic Aviation Corporation's plant and airport was taken in the early 1960s, the facility looks almost the same as it did at the close of P-47 production in November 1945. World War II Civil Defense camouflage can still be seen painted on the roof of Building 17 at left of the main factory. The Building 29 complex is visible at center right, with the curved corner facilitating a railroad spur leading directly into the plant. Adjacent to the rail line running diagonally at bottom of photo at left is Building 5, original home to Fairchild, American, Grumman, Seversky, and Republic. Note extension to Runway 32/14 at upper edge of photo built to accommodate Republic's new fighters built during the war. View is looking to the south southeast. (Craig Kaston via Author Collection)

With XF-12 Ship Two in the background being readied for its first flight exactly one week after this photo was taken on 5 August 1947, Building 17 is filled with RC-3 Seabee amphibians at about the mid-point of their 1,063-aircraft production run. RC-3 Ships 423 and 436 are visible in the foreground while on the building's north side, the very beginning of F-84 Thunderjet final assembly is getting underway. Compared to the scene inside this building at the peak of P-47 production only a few years earlier, there is a fair amount of empty floor space showing. (Author Collection)

Tough Decisions at Farmingdale

Unlike larger aircraft manufacturers such as Boeing, Douglas, Lockheed, and North American, each with sprawling facilities in multiple locations, Republic was a relatively small outfit situated in the placid suburbs of New York. Although the plant was located on the northern periphery of its own private airport, the total land area occupied by the manufacturing facility was only 500 square acres—less than half the area of the West Coast giants. The company's dynamic and dedicated workforce was drawn directly from the myriad suburban communities in the surrounding area whose local economies ebbed and flowed with the tide of Republic's fortunes and losses. In 1946, the future for those Long Island communities looked tenuous at best.

Certain industries experience boom-and-bust cycles by nature. It is an inherent part of their business. Aircraft manufacturing has always been one of those industries because the products being built are created to meet specific technical and operational demands highly susceptible to ever-changing economic factors. If anything, these

demands are always in a state of flux, even as contracts are being written, and when operational needs suddenly change, coupled with shifting economic factors, aircraft programs can be terminated and thousands of employees can be laid-off as a result. Ultimately, entire corporate fortunes can be put at risk in a surprisingly short period of time as a result of shifting trends or other external factors completely beyond a company's control.

Such was the case for Republic after successfully producing more than 15,000 P-47 Thunderbolt fighter-bombers during World War II. Despite achieving impressive production rates, not to mention the realization of national wartime objectives, within one year after the German and Japanese surrenders, the fortunes of the Republic Aviation Corporation were in serious peril. While wartime production at its peak employed 25,000 workers in Farmingdale and Evansville, Indiana, after the war the Evansville plant was shut down and the workforce in New York was slashed dramatically to 4,800 employees as activity at Farmingdale rapidly wound down to pre-war levels. The XF-12 Program, and its sibling Rainbow airliner, were seen as welcome, if not essential, ways to successfully bridge the gap from a bustling wartime industry to a world finally at peace once again. Perhaps this time, Republic would be able to grow, expand, and join other industry giants like the aircraft manufacturers located in the Midwest and on the West Coast.

New Leadership Regime

Republic sought strong leadership to help the corporation through the transition from the military storm clouds of war to the economic storm clouds of a national recession. In April 1941, company president Walter Kellett moved up to the position of Republic's chairman of the board, and was replaced by the former president of Curtiss-Wright and also former president of American Airlines, Ralph Damon. A brilliant businessman and veteran airline administrator, Damon had been recruited to provide the necessary guiding hand as Republic's chief executive during a time of explosive expansion as wartime production ramped up to unprecedented levels of output.

In 1943, with plant operations humming along at peak efficiency and productivity, Ralph Damon moved on, eventually taking an executive position with Trans World Airlines and working closely with its owner, Howard Hughes. Damon was replaced as Republic's president by Alfred "Fred" Marchev, an industrial marketing specialist who was tasked by Republic's Board of Directors with developing vital new programs to ensure the company's survival after wartime production spooled down. Recognizing the need for expansion into the civilian market to accomplish that objective, Marchev sought projects that would be unique, highly marketable, and ultimately profitable. He turned his attention to the development of a small, low-cost "family airplane" that could be efficiently mass-produced, and that would place Republic in an advantageous position to tap into a new and highly anticipated market. If the idea worked, he would be a hero. If it didn't, the airplane would be forever known as "Marchev's folly."

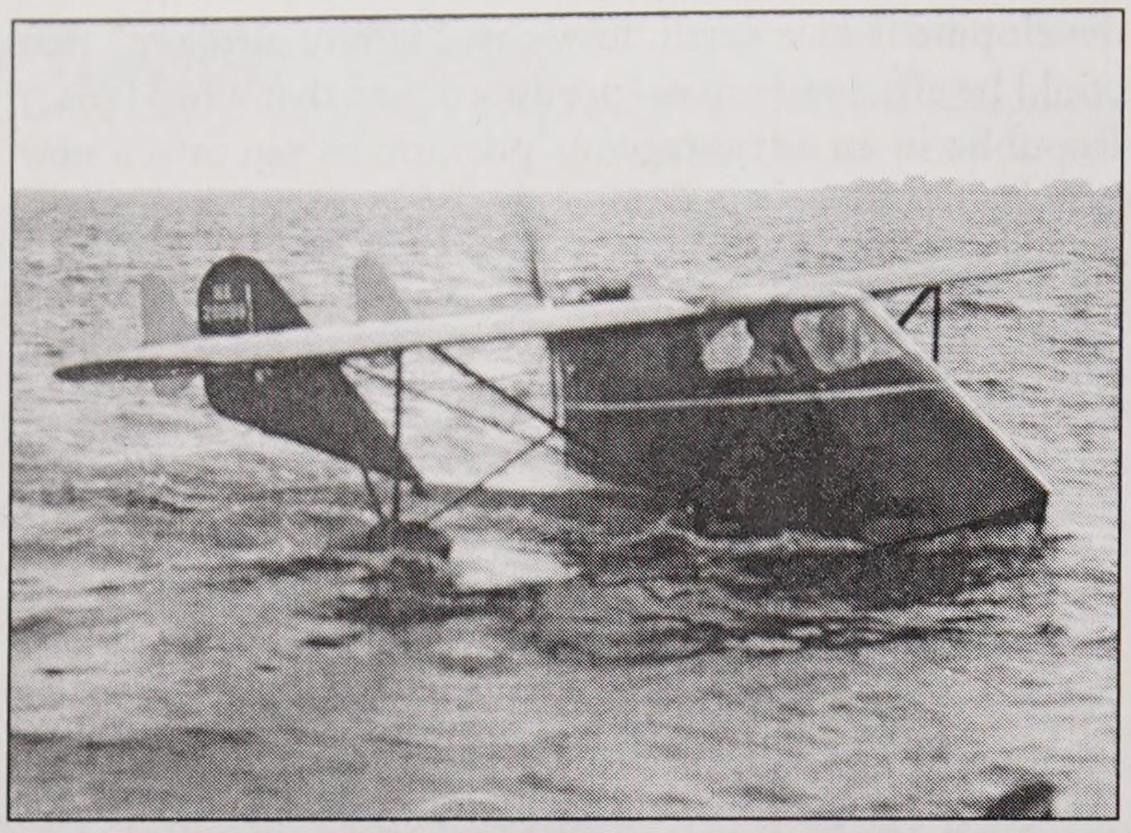
From Thunderbolt Amphibian to Seabee

By spring 1945, it was becoming increasingly clear that the long-awaited Allied victories of World War II would soon be at hand in both the European and Pacific theaters. With American military pilots numbering in the many tens of thousands, it stood to reason that a potential market for the light airplanes these legions of pilots would want to fly when they returned home would also equal tens of thousands of new aircraft, and associated manufacturing jobs as well. The U.S. Department of Commerce had over-optimistically forecast the need for 200,000 new light airplanes to meet the predicted pent-up demand at war's end, and many aircraft manufacturers saw this potential as being simply too good to pass up. Whether they were established companies like Piper, Cessna, Stinson, or Taylorcraft already building small "private planes" (as was the term before "general aviation"), or large military manufacturers producing top-of-the-line fighters or bombers, a total of 55 U.S. aircraft builders had light aircraft designs either for sale or under development, and were ready to jump on the bandwagon.

Of the dozen or so major U.S. aircraft manufacturers building military aircraft during World War II, four companies threw their hat into the ring to build the ultimate light airplane. North American parlayed elements of its magnificent P-51 Mustang design into a beautiful single-engine, low-wing, four-seater called the Navion. Douglas took its novel pusher-prop XB-42 Mixmaster bomber and shrank it down into a sleek-looking private aircraft prototype called the Cloudster II, playing on the name of Douglas's very first airplane. Lockheed had three aircraft in its stable, Big Dipper, Little Dipper, and Model 60. Republic got into the act by modifying an existing small pusher-prop, two-seater called the Air Car, but unlike the Navion, Cloudster II, or Lockheed Dippers, this little aircraft could take off and land on water as well as a runway.

Designed by aviation impresario and company employee Percival Spencer (who later became a Republic test pilot, by the way), this unique-looking amphibious aircraft was unlike anything else in the air at the time. Housing its occupants in a tadpole-like fuselage mounted on a boat-like hull, the Air Car held great promise as a versatile aircraft design that would be in strong demand by pilots returning home from the war, or so hoped Republic's President Marchev.

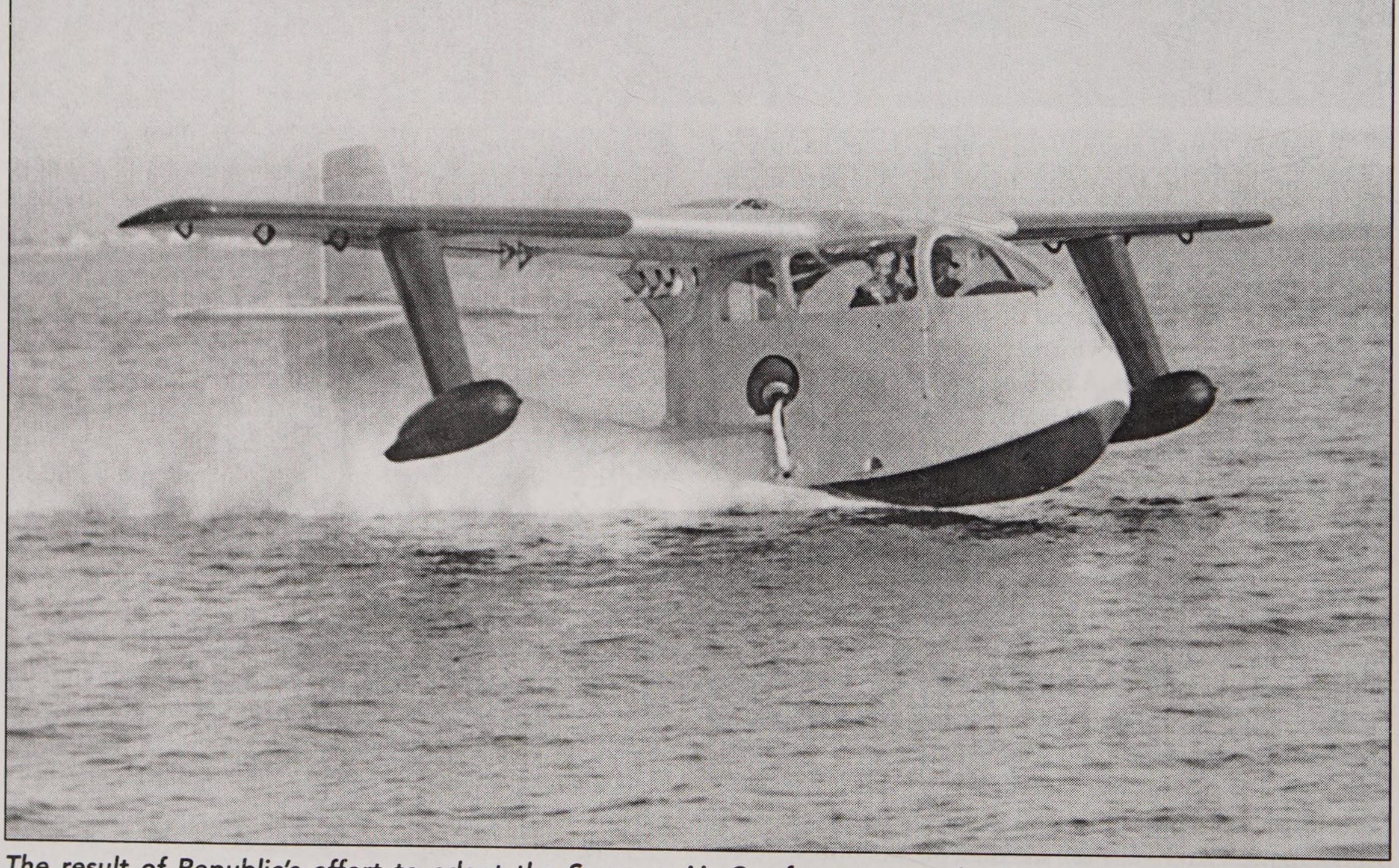
Upgrading and adapting the Air Car for mass production was a novel challenge for Republic engineers,



The Spencer Air Car was the first step in the process of Republic building an amphibious general-aviation airplane. This novel two-seater was chosen by Republic's new president, Alfred Marchev, to be adapted for mass production in anticipation of an expected land rush business for light aircraft after World War II ended. (Howard Levy via Author Collection)

however; and they soon named this new water-borne craft the Thunderbolt Amphibian. Designated as the RC-1 for Republic Commercial number-one, the T-Bolt amphibian was touted in early marketing material as the perfect machine for a young pilot starting a family of his own. After all, what could be better than packing the wife and kids into your very own flying boat, then taking off from a little hometown airport and flying to that idyllic campsite on a placid lake nestled in the mountains? Beautiful airbrush illustrations of the Thunderbolt Amphibian soon graced double-page ads in U.S. aviation magazines, and a nationwide dealer network of some 30 distributors was established. Projected sales figures hovered at the 1,800 mark.

Powered by a 175-hp six-cylinder Franklin engine, the RC-1 prototype first flew in July 1944 and underwent initial flight testing in the calm waters surrounding Long Island. Performance results indicated the RC-1 could achieve a top speed of 120 mph, and takeoff after only a modest 25-second 1,000-foot run on the water. Although this new single-engine, high-wing seaplane appeared promising, the production cost of such a



The result of Republic's effort to adapt the Spencer Air Car for mass production was the RC-1 Thunderbolt Amphibian, shown here on the step while taking off from Long Island's Great South Bay on 15 May 1945. RC-1 was powered by a 175-hp Franklin engine that gave the little seaplane a stately cruising speed of 100 mph. (Republic via Author Collection)

machine came into focus as being prohibitive. Its tapered wing, faired wing floats, and retractable landing gear were features of much-higher-priced aircraft, and the little ship's conventionally riveted smooth aluminum skin would make the airplane too costly to build and sell profitably. Projected purchase price of the production aircraft was computed at a whopping $12,000—more than the average price of a new house in those days.

A new design team was established to solve these problems, and "the little seaplane that could" turned from a graceful swan into a handsome, but more practical and more rugged duckling. The RC-1's tapered cantilever wing was replaced by a stubbier constant-chord "Hershey Bar" wing, so named because of its rectangular plan view. Instead of the tapered wing's complicated internal structure, this new design was constructed using only three internal ribs identical in size and shape affixed to a main spar, but with a thicker aluminum skin using beaded external ribs to carry the air loads. The craft's landing gear was simplified by being left exposed on the sides of the fuselage, and the RC-1's narrow tadpole-like cabin was enlarged and refined into a roomier four-seat design. With its very comfortable and accommodating automobile-like interior, the 'Bee featured a large bow door on the right-hand side of the nose, allowing pilot and passengers to cast their fly rods while standing inside the airplane. This redesigned version of the Thunderbolt Amphibian received an upgraded 215-hp Franklin engine and a new name as well, honoring the courageous men of the U.S. Navy's Corps of Combat Engineers known as the Seabees. Hence, the Republic RC-3 Seabee was born.

RC-1 Thunderbolt Amphibian warming up for a test flight on the east ramp at Republic Field with none other than company president Marchev seated behind the pilot. Aircraft had just received its new twin-striped paint job. (Republic via Author Collection)

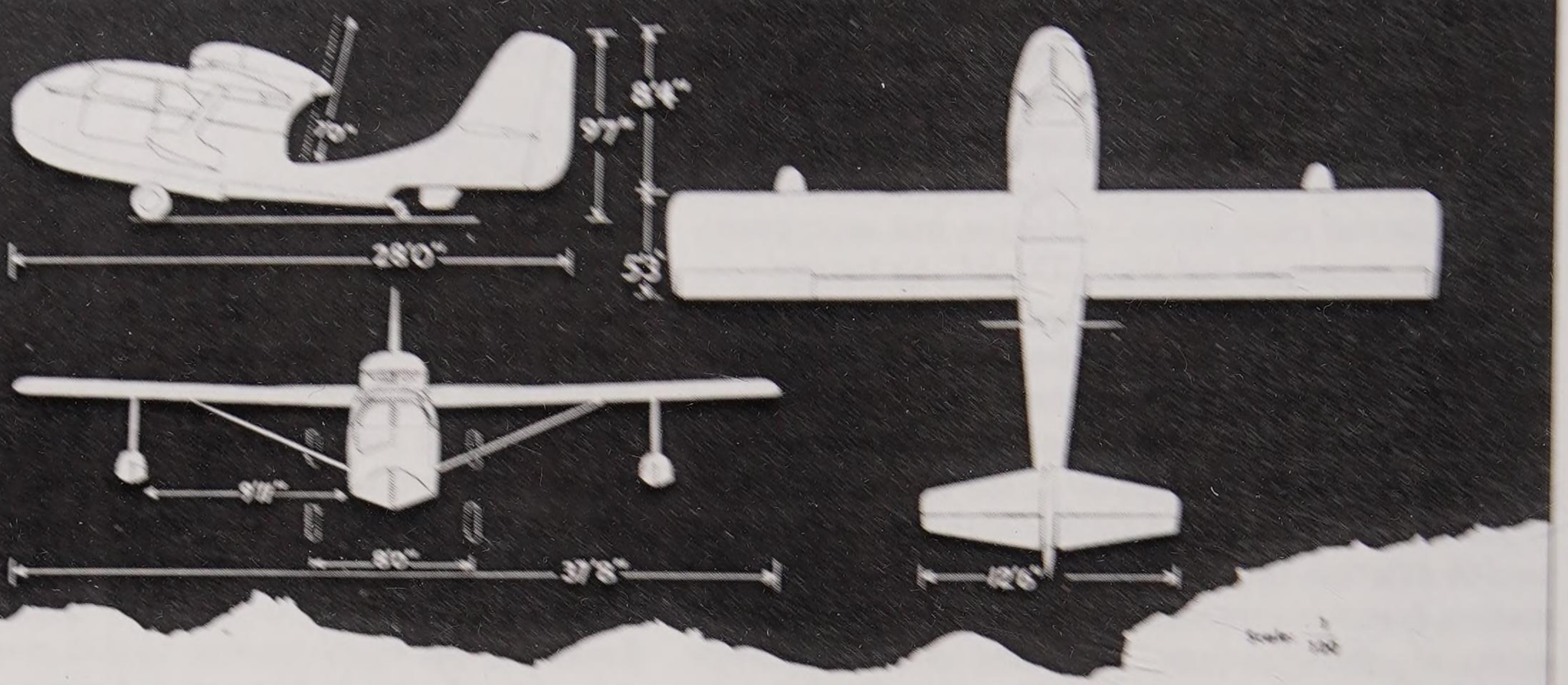
With an original fly-away-Farmingdale price of $3,995, the Seabee looked like a world-beater, but marketing dreams soon began to collide with economic realities. After V-E Day (Victory in Europe, June 1945) and V-J Day (Victory in Japan, August 1945), those tens of thousands of military pilots did indeed return home and either married the sweethearts who awaited them, or returned to the families they left behind to restart their lives. Buying a new airplane became a fairly low priority when compared to finishing college on the G.I. Bill or starting a new family and buying a new home—also with G.I. Bill benefits. Also, although company promotional material still showed a purchase price of $3,995 in January 1946, by November of that year the purchase price for a Seabee had increased dramatically to a much more formidable $6,000. Although Republic had accumulated roughly 4,000 orders, nearly all of them evaporated as the continual price increases were announced.

By the end of 1946, other factors overlooked by the marketing mavens began to burst the light airplane market bubble, and not just for Republic, either. Flight schools, throbbing with business only months before, reported an exceedingly high percentage of students dropping out after obtaining only their Private License. Also, despite companies like Piper and Aeronca having sold 7,000 cheaper-priced light airplanes that year, inventories at many small aircraft manufacturers were beginning to grow rather rapidly. Couple this with a deepening post-war recession and you have all the makings of exactly what happened to the light airplane market by mid 1947: complete and utter collapse.

Although Republic had expected to sell thousands of Seabees, only 1,063 of the little all-metal amphibians were ever built, and most of those were sold at a financial loss to the company. A number of Seabees were also lost in accidents when new owners and operators filled the spacious cabin to capacity and then attempted flights in hot weather and at high elevations. As word of these accidents spread throughout the aviation community, the negative publicity began to have an effect on sales. When production finally ended in late 1947, more than 200 unsold Seabees lined the taxiways at Republic's airport, and the little seaplane was considered to be an ultimately unsuccessful venture for the company.

Ironically, Seabees are considered valued vintage aviation classics today, with nearly 250 of them still flying throughout the world. Countless Seabee restoration groups have sprouted up over the years, and beautifully restored examples can always be found at vintage seaplane "splash-ins" around the country.

LATEST Seabee SPECIFICATIONS



Scale 1/48

GENERAL:

Model	RC-3
Type	Amphibian Monoplane
Seats	4-Place
Construction	All-Metal
Flight Instruments	Basic CAA and Ball Bank
Radio (Two-way)	Tower and Range
Propeller	Ground Adjustable*
Price	$3995 FAF Farmingdale

PERFORMANCE:

High Speed	120 MPH
Cruising at 75% Power	103 MPH
Landing Speed	58 MPH
Climb First Minute	700 ft. per minute
Range at Cruising	560 miles (75 Gals.)
Full Load Condition	
Take Off Land	800 ft.
Take Off Water	1000 ft.
Take Off Time Water	25 seconds
Landing run land	400 ft.
Landing run water	700 ft.

POWER PLANT:

Make and Model	Franklin 6AS-215-B7F
Horsepower and RPM	215 at 2500
Fuel used at Cruise	13.5 gals. per hr.

WEIGHTS:

Gross Weight	3000 lbs.
Empty Weight	1950 lbs.
Useful Load	1050 lbs.

DIMENSIONS:

Span maximum	37'8"
Length maximum	28'0"
Height maximum	9'7"
Wheel Span main gear	8'0"
Cabin Width (Interior)	46"
Cabin Height "	50"
Cabin Length "	110"
Baggage Compartment 20 cu. ft.	
Draft, loaded	15"

LOADING SELECTIONS:

2 PEOPLE (Pilot & 1 Passenger)	340 lbs.
75 gal. Fuel (5.5 hrs. at Cruise)	450 lbs.
3 gal. Oil	20 lbs.
Baggage	240 lbs.
TOTAL	1050 lbs.
3 PEOPLE (Pilot & 2 Passengers)	310 lbs.
71 gal. Fuel (5.3 hrs. at Cruise)	426 lbs.
3 gal. Oil	20 lbs.
Baggage	94 lbs.
TOTAL	1050 lbs.
4 PEOPLE (Pilot & 3 Passengers)	680 lbs.
45 gal. Fuel (3.3 hrs. at Cruise)	270 lbs.
3 gal. Oil	20 lbs.
Baggage	30 lbs.
TOTAL	1050 lbs.

*Controllable and reversible pitch propeller optional equipment at $323. extra.

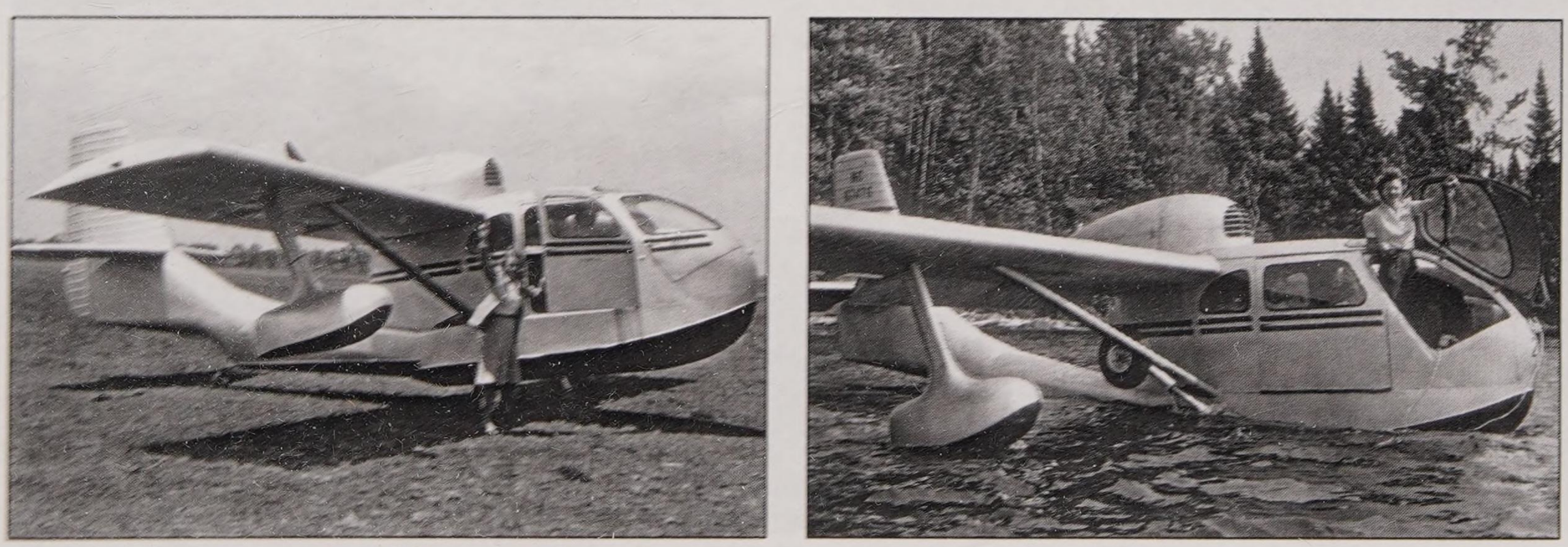
NOTE: These specifications are subject to change without notice.

1-15-46

REPUBLIC AVIATION
CORPORATION

Original RC-3 Seabee specification sheet showing fly-away-Farmingdale cost of $3,995. This overly optimistic purchase price had climbed to $6,000 less than twelve months later, which spelled the death knell for Republic's hopes at success in the postwar "private plane" market. (Republic via Author Collection)

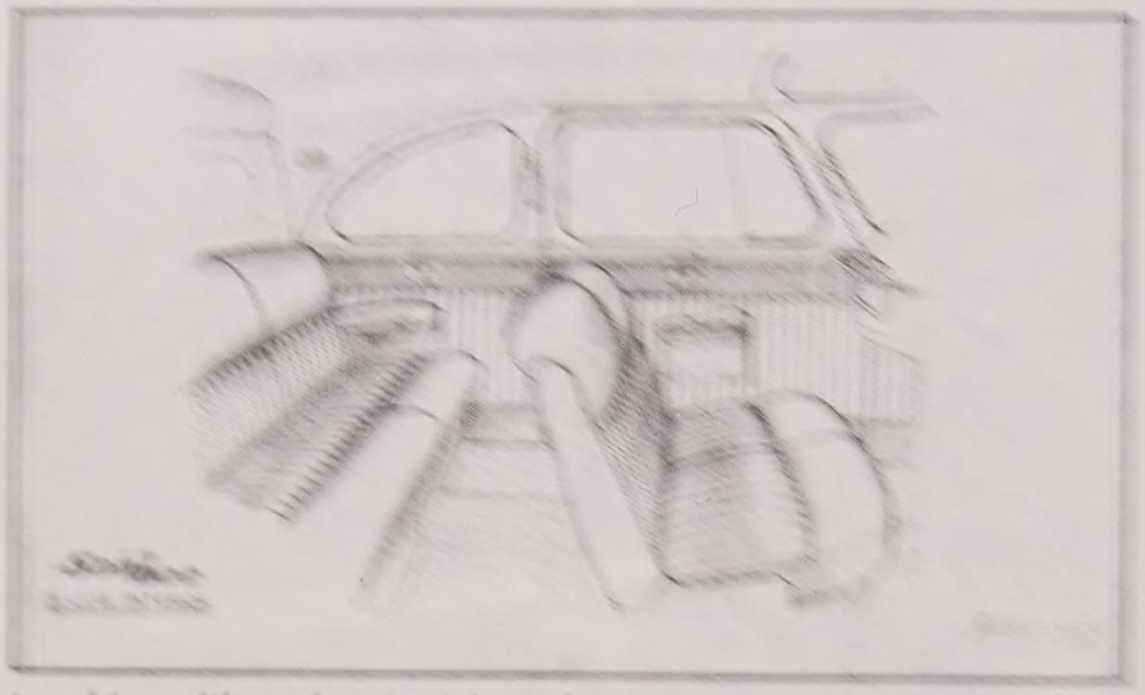
Good things come in threes, and this formation of RC-3 Seabees reinforces that point. The Seabee had a very distinctive sound when in the air, caused by the shockwave from its propeller tips hitting the aircraft's hollow metal tail boom. One can only imagine the sound of three Seabees flying at once, and leave it to a manufacturer of military fighters to stage a formation of amphibious seaplanes like this one. (Republic via Author Collection)



"One if by land" and "one if by sea." These factory photos show the Seabee both on the grass in the middle of Republic Airport and in the water. First flight of the RC-3 took place on 1 December 1945 with Percival Spencer at the controls. Engine was an upgraded 215-hp Franklin, which allowed short 1,000-foot-long takeoff runs on water. Note ample-size bow door open for fishing in the right-hand photo. (Republic via Author Collection)

The Anticipated Commercial Airliner Market

While Republic was attempting to enter the light airplane market with the Seabee under Muncher's direction, the company was also developing an airplane to meet the needs of the world airline industry. In so doing, it had high hopes of capturing a triple crown of market share: light civilian airplanes, military jet fighters, and large commercial airliners. Although conceivably taxing the small Farmingdale production facilities to the hilt, this



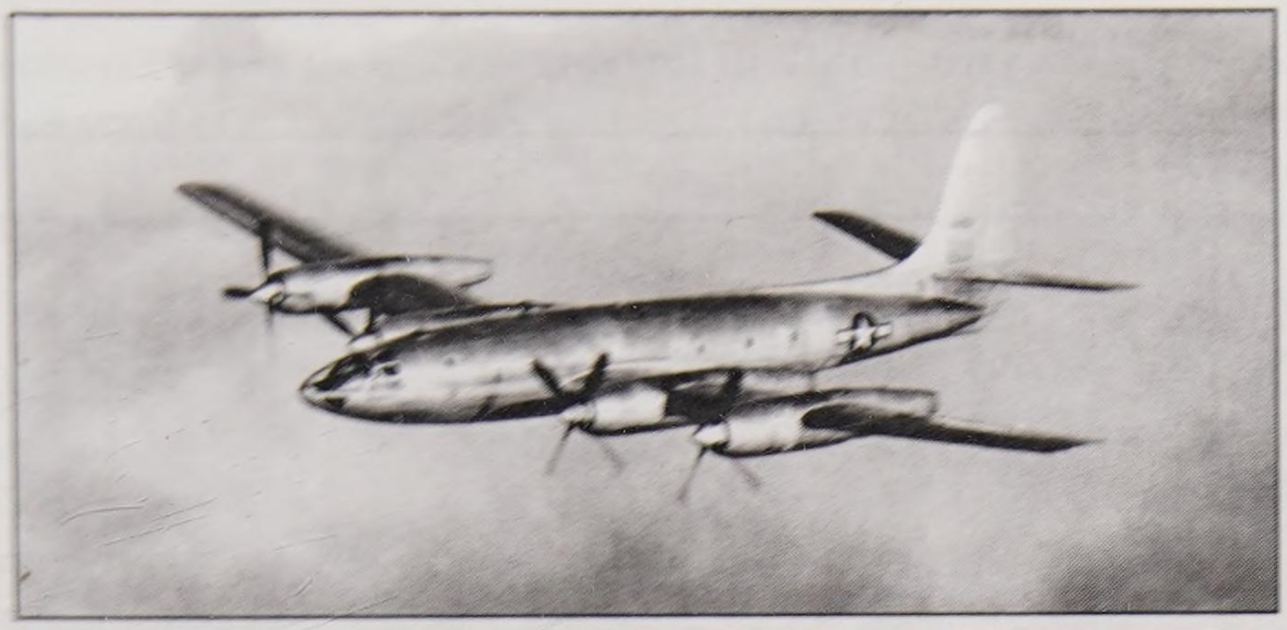
Looking like the inside of a sporty 1940 two-door coupe, the automobile-like Seabee "Deluxe Interior" gives a good indication of how the airplane was marketed to the public. Upper part of seat detached as a life preserver. (G. Hildebrand via Author Collection)

potential manufacturing gold mine would have ensured a bright and prosperous future not only for the company itself, but for the surrounding population centers on Long Island that provided Republic's talented workforce.

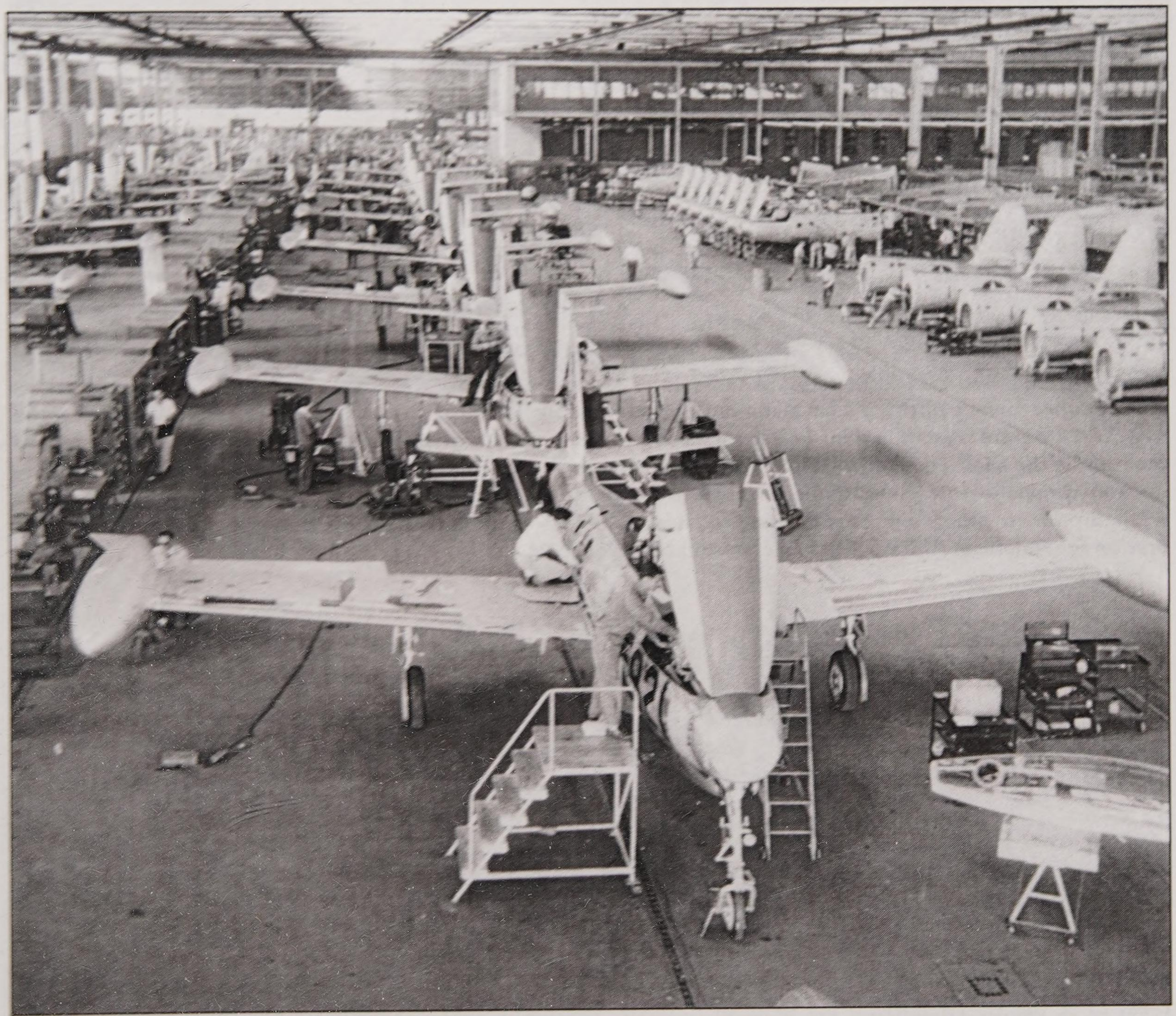
Although the Seabee and P-56 Thunderjet were pioneering airplanes in their own right and handily represented Republic's civilian light airplane and military product lines, Republic's proposal for a new high-speed long-range airliner was in a class by itself. Harnessing the impressive performance of the XF-12 with its top speed of more than 400 mph, this new airliner offered the potential for unprecedented service for the world's leading airlines. With an impressive 40-passenger commercial adaptation of the XF-12 named the RC-2 Rainbow, Republic could offer the world's commercial carriers an airplane that promised—in 1946—near-jet-like cruising speeds and altitudes in addition to an extraordinary 4,000-mile intercontinental range.

Airlines quickly took notice, designs were developed and marketed, and mockups were built and studied by several major carriers. However, despite the RC-2's promising performance, the same inevitable economic factors cited in the Seabee's demise came into play on an even larger scale when nationwide airline operations were factored in. Fate ultimately played out once again for Republic, and the RC-2 Rainbow never left the drawing boards. (See Chapter Eight for more information.)

Considered a sales flop when production ended in October 1947, the Seabee is now a rare and prized vintage classic, such as this stock example at Lake Tahoe in 1980. In the 1960s, 24 Seabees were even converted to a twin-engine configuration with two 180-hp Lycoming IO-360 engines mounted on their wings. Other updates have included structural mods for improved performance, three-blade constant-speed props, and any number of uprated powerplants. One modern conversion wedges a snarling 405-hp Corvette LS6 V-8 engine into the Seabee's original engine cowling with no other major modifications to the airframe. (Mike Machat)



Once the XF-12's configuration was defined (left), it wasn't hard to imagine the sleek four-engine aircraft as an airliner. A similar view (right) shows the military prototype XF-12 in an artist's retouched photo derived from a model, illustrating how the RC-2 Rainbow might appear wearing basic airline markings. Republic's hopes for the future were pinned to these two aircraft and the smaller RC-3 Seabee amphibian. (Cradle of Aviation Museum via Dennis R. Jenkins)



What a difference a year can make. With control of the corporation wrested from President Marchev in 1947, the company's focus returned to the manufacturing of military fighters bringing Republic back from the brink of bankruptcy. Compare this scene of F-84 Thunderjet production in August 1948 with the interior photo of Building 17 on page 30 taken one year earlier. (Author Collection)

Chapter Four

This Republic "family portrait" was taken on an unseasonably warm day in late December 1944. At center is the new XF-12 before its national insignia and "Republic Rainbow" logotype had been painted on the aircraft. To the right is the RC-1 Thunderbolt Amphibian, predecessor to the RC-3 Seabee. To the left is a P-47N, final production variant of the Thunderbolt series. In front of Hangar 2 in the background is a Douglas C-54 being washed prior to undergoing modification to have its military cargo interior converted into a passenger configuration for American Airlines. (Republic via Author Collection)

Contract, Mockup and Rollout

In 1946, with Republic's commercial aircraft programs well underway, the additional need for the company's military orders for both the XF-12 recon airplane and the new P-84 jet fighter was of the utmost importance. The P-84, to be named Thunderjet, was destined for long-term production and became a stalwart Air Force fighter-bomber during the Korean War, but was the first of its breed. As such, it represented the very beginning of a new technological era.

The XF-12, on the other hand, was an airplane well ahead of its time in 1946, and to this day, is still the fastest four-engine piston-powered airplane ever flown. The aircraft was created for one definitive purpose: to fulfill the stringent new USAAF requirement for a high-speed, long-range, high-altitude photo-reconnaissance aircraft capable of taking high-definition aerial photographs day or night. Furthermore, the flight crew of this aircraft would be fully capable of developing these images

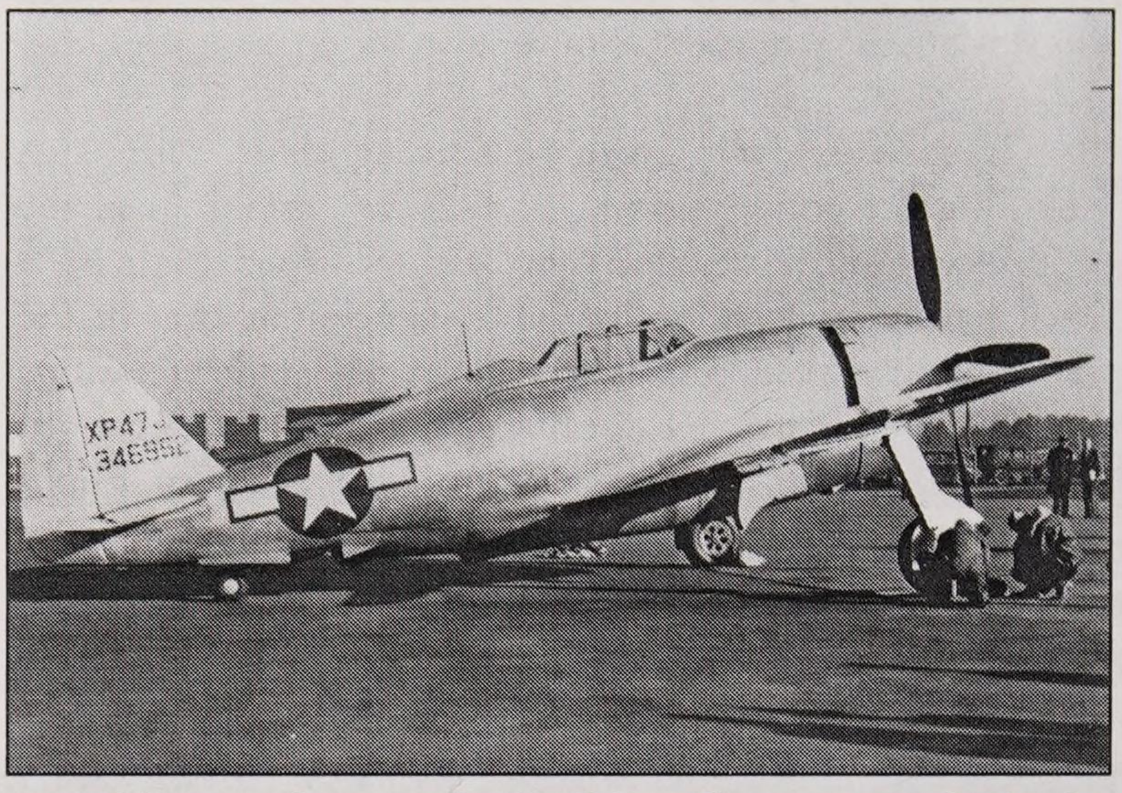
onboard while the aircraft was still in flight—a revolutionary idea at the time.

Contract Award at Last

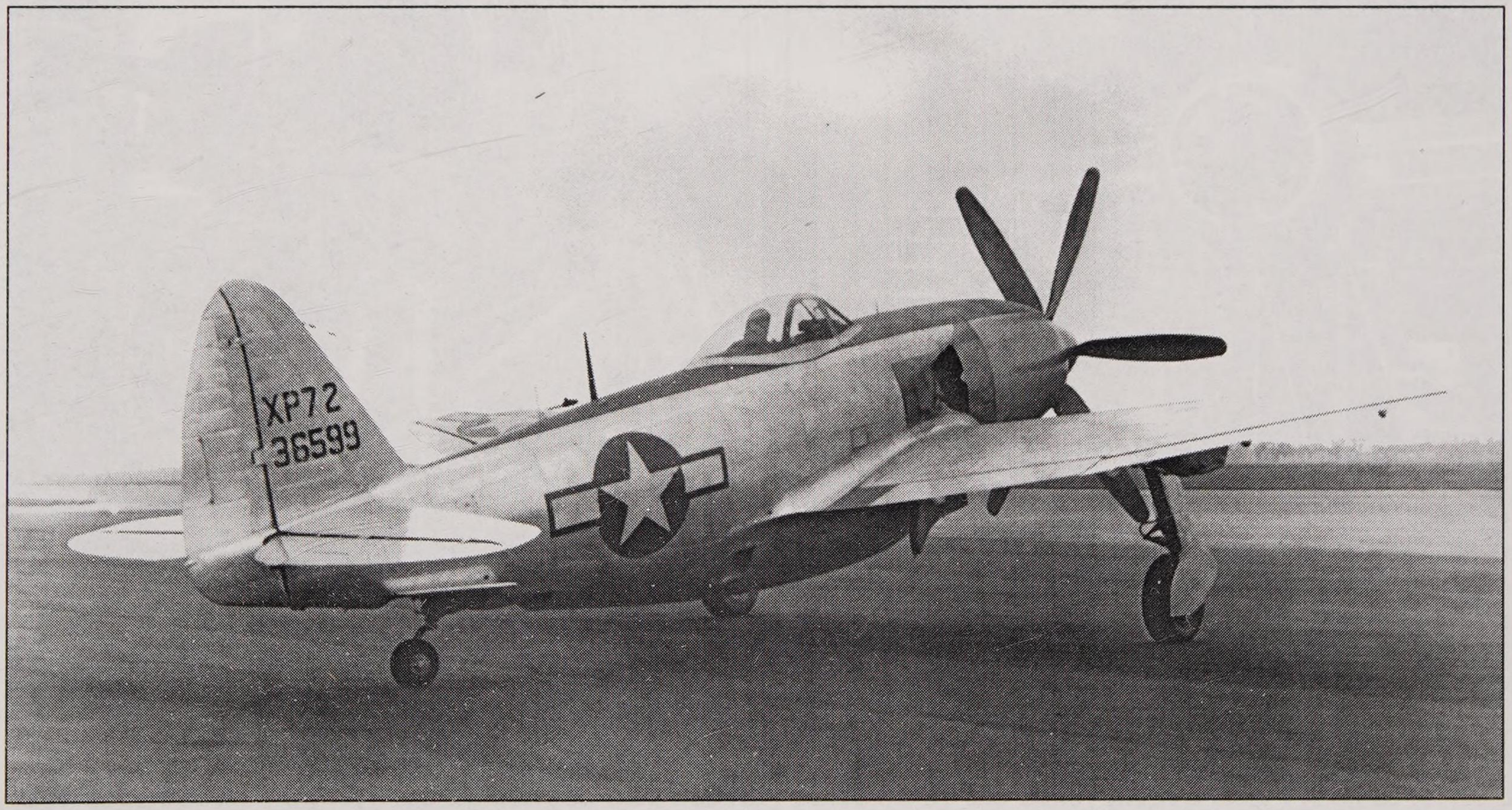
In March 1944, a "cost-plus-fixed-fee" production contract, number W-33-038-AC-2135/AFP-296822, was awarded to the Republic Aviation Corporation by the U.S. Army Air Forces Materiel Command Headquarters at Wright Field. This contract called for the construction of two prototype "photographic airplanes" with an estimated delivery date of September 1945 for the first article and February 1946 for the second. The amount specified was $6,461,877.80 plus $255,634 in fixed fees. (An additional $512,932 was paid by the USAAF for cost overruns incurred by Republic in November 1945.)

Upon formal acceptance of the government contract, dedicated space for specified quarter-scale wing models and a full-scale airframe mockup was quickly established in Building 17 on the east side of Republic's main manufacturing buildings. A full-scale mockup of the XF-12 was completed in June 1944, and inspection of the mockup took place from 26 June through 29 June. This formal inspection was conducted by military and civilian representatives of the USAAF Air Service Command Aircraft, Powerplant, Propeller, Radio, Equipment, Photographic, Personal and Aero-Medical Laboratories; and Technical Staff. Observers from the U.S. Navy and U.S Marine Corps were also present, as were a Royal Air Force wing commander and additional British personnel.

Although initial reaction by the technical observers and inspection committee was favorable, much attention was given to the aircraft's novel and unique nose section, specifically with regard to anti-icing protection and provision for emergency vision should the large plexiglass outer fairing be compromised or damaged in any way. Specific finding of the mockup review committee included the following:



Republic was known for building fast, rugged, single-seat fighters, but the "lightweight" XP-47J was the company's first attempt at creating an ultra-high-performance aircraft that could assault the 500-mph barrier. Note early attempts at pilot visibility enhancement with the augmented Plexiglas sections aft of the cockpit canopy. (Republic via Author Collection)



Minus its wings and tail section, the one-of-a-kind XP-72 was, in essence, one engine nacelle and contra-rotating propeller of the original XF-12 concept. Powered by the same Pratt & Whitney R-4360 radial engine that propelled the XF-12, this advanced Thunderbolt proved to be a critical propulsion technology test bed and became a vital link between the P-47 and XF-12. (Republic via Author Collection)

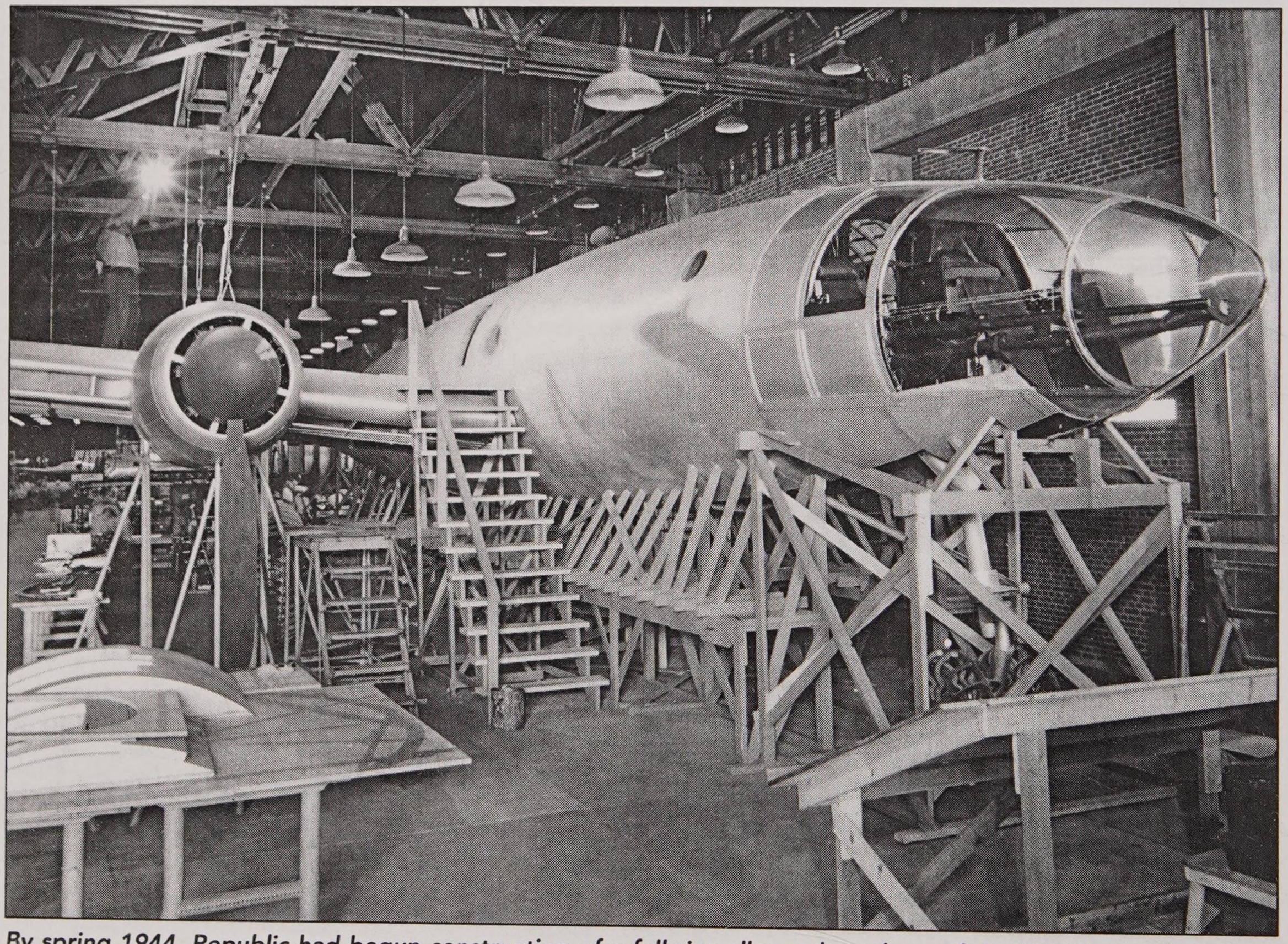
- A need for protection of the transparent nose section during manufacturing, fabrication, and installation in the factory.
- Provisions for emergency vision during landing should areas through which normal vision is available become opaque due to fog, frost, rain, or ice.
- A study to determine different methods and the practicality of anti-icing the entire nose section with hot air blown over its outer surfaces.

Great effort was given to solving these problems, including the construction of a full-scale mockup of the cockpit and nose section that was mounted high on a truck bed at the same pilot's-eye position as that of the actual airplane. Numerous test runs were made at various speeds up and down Republic's main runway at night and in the rain with the company's Director of Flight Test, Lowery Brabahm, in the aircraft commander's seat. These tests helped define the optimum angle and configuration of the XF-12's fixed windscreen and faired Plexiglas surfaces.

Additional findings by the committee included identifying improvements to be made to the aircraft's emergency egress hatches and doors, cabin heating and associated ducting, cockpit and cabin lighting and insulation, cockpit control-panel layout, switch positions and indicators, and such operational items as the addition of a small wide-angle mirror to the flight engineer's instrument panel allowing him to view the number-one and number-two engines while seated at his control station.

For the photographic mission, the committee suggested the removal of certain supplemental camera systems, leaving the three-bay single vertical, split vertical, and trimetrogon camera configuration that was eventually fitted into the cabin of the second XF-12 prototype. Stowage space was also specified for the following onboard equipment:

- Four photographic cone assemblies
- Six Type A-9 film magazines
- One Type A-8 film magazine
- One type K-19 camera
- Eight rolls of 9.5-inch x 205-foot film
- Twelve rolls of 9.5-inch x 390-foot film



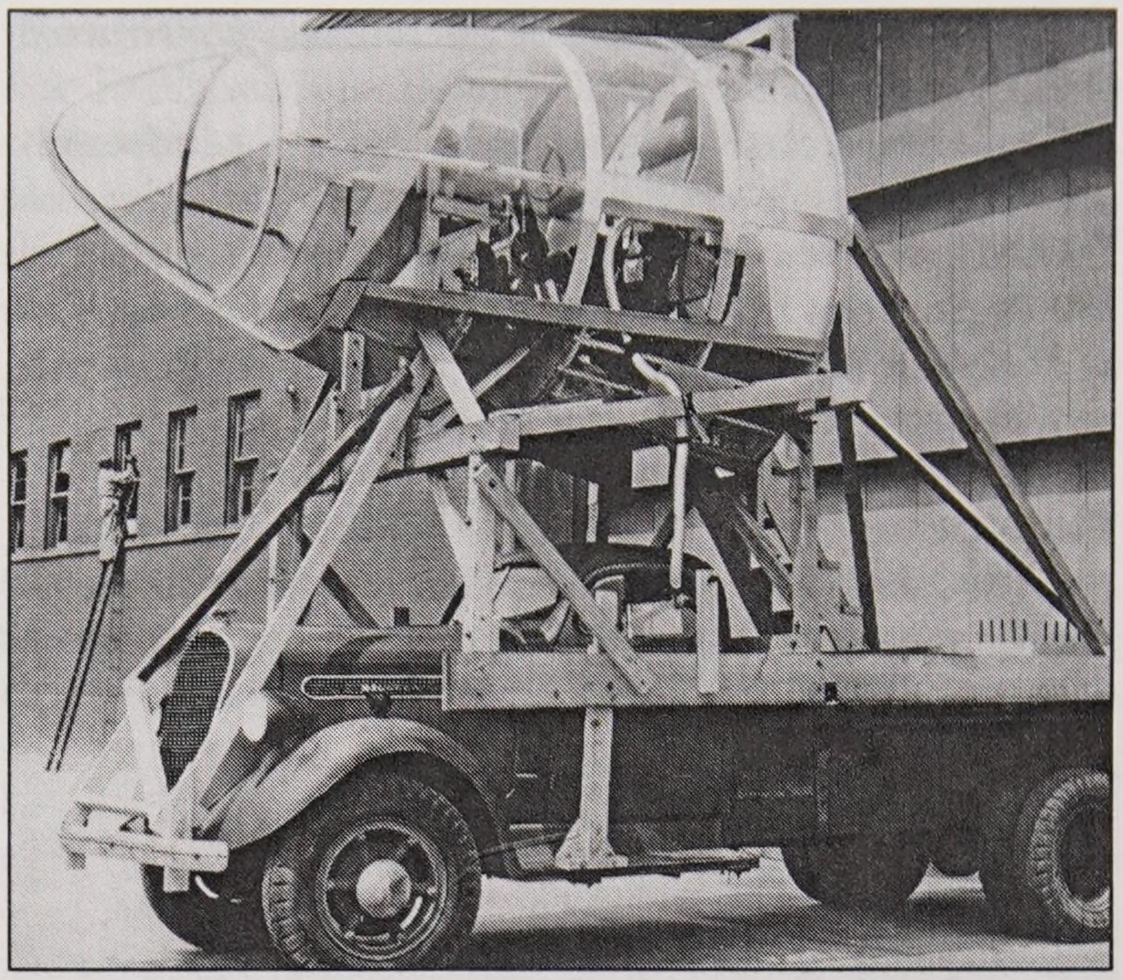
By spring 1944, Republic had begun construction of a full-size all-wood mock-up of the XF-12 aircraft. In making the transition from two-dimensional drawings into a three-dimensional airplane shape, this mock-up gave the USAAF inspection team its first glimpse of their new long-range photo-recon aircraft. Note the early cockpit window configuration aft of the clear tapered nose section. (Courtesy of Ryan Crierie)

These recommendations were made with the full intent that all would be accomplished prior to photographing the completed mockup structure, and that all changes and modifications would be fully incorporated into the actual aircraft when built. Final approval of the revised mockup was granted in November 1944.

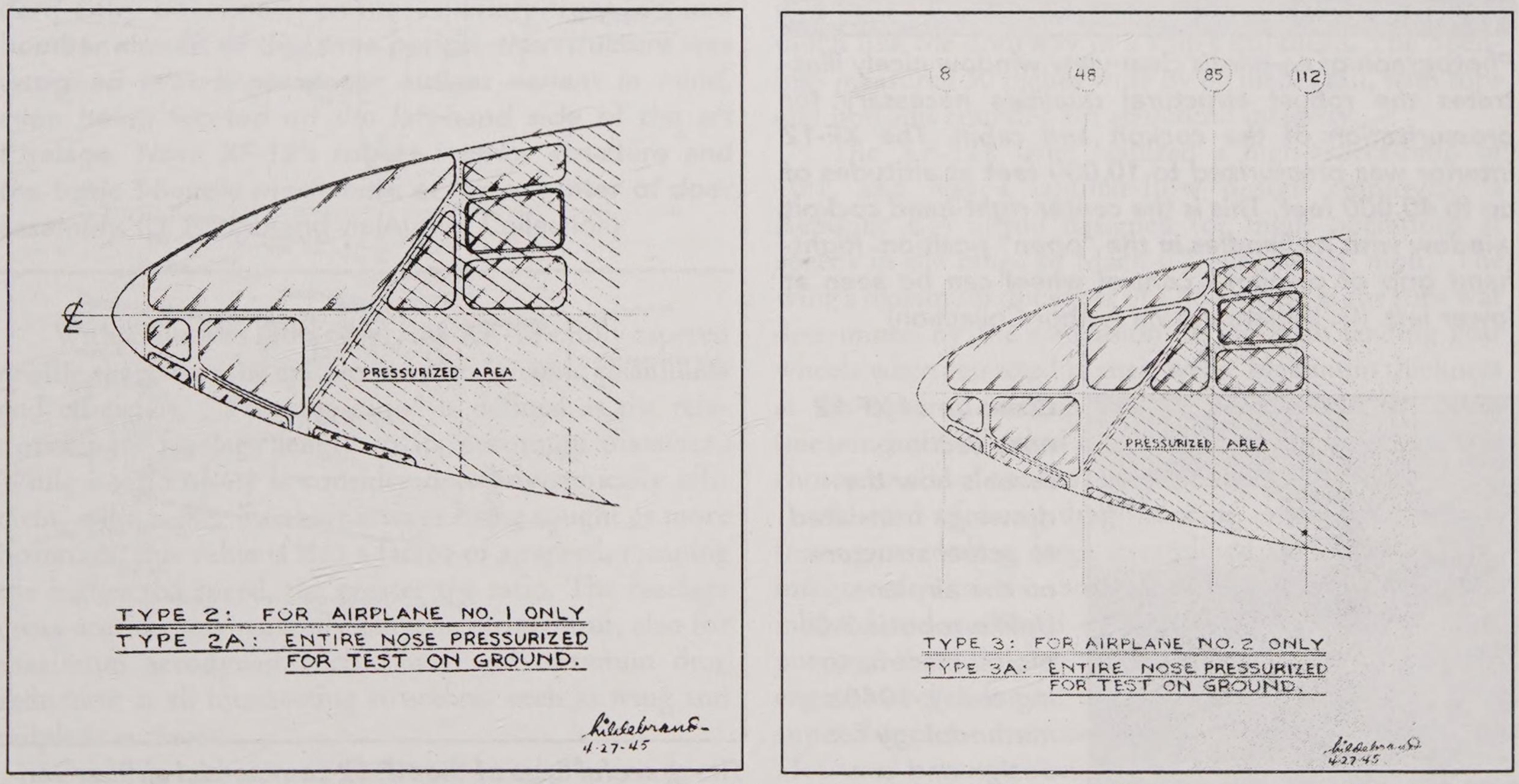
Aircraft Description

With sleek lines that are often mistaken today as being those of a much more modern turboprop, the XF-12 embodied a rather conventional aerodynamic configuration for the postwar era. Its most noticeable structural characteristics were a bullet-shaped clear nose section and four engine nacelles that extended well fore and aft of the wing. Nearly as long as a P-47 fuselage, these nacelles resembled large streamlined fuel tanks, and appeared as though they were imbedded in the wing. The XF-12 used the same 28-cylinder Pratt & Whitney R-4360 Wasp Major powerplant as Boeing's B-50 Superfortress and new C-97 transport, a design that soon emerged as the luxurious Model 377 Stratocruiser commercial airliner. However, with its more streamlined aerodynamics and lighter overall gross weight, the XF-12 enjoyed an almost 100-mph advantage in top speed over either of the two Boeing airplanes.

The XF-12 was described as being a conventional four-engine transport with its wing at mid-height mounted mid-fuselage, and with conventional vertical



Studebaker flat-bed truck serves as proper ground transportation for full-size mock-up of the XF-12 nose section, complete with pilot seats, flight controls, throttle quadrant, and dual instrument panel housings. Original configuration of the nose section's framework seen here was modified into the design of the actual airplane as a result of the ground tests performed with this rig. Note the accurate deck angle of the nose section replicating the aircraft's attitude on the ground, and metal flex-tube connecting the truck's cab with the nose mock-up. (Cradle of Aviation Museum)

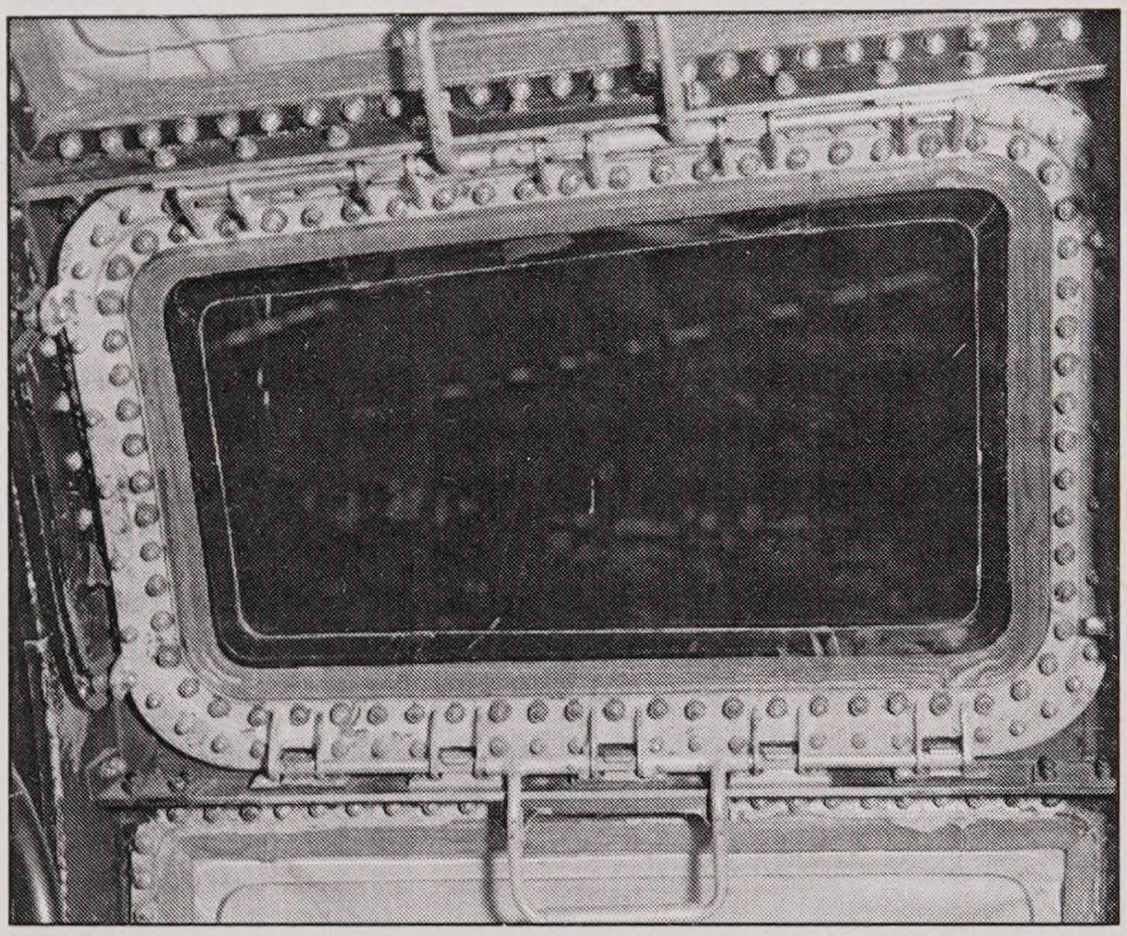


Here are several design configurations for the distinctive nose section of the XF-12. Pressure vessel for the fuselage began at the flat, forward windscreen that was fully enclosed by the bullet-shaped clear Plexiglas forward fairing. Ambient air was contained within the forward section only, the upper halves of which were to be retractable for night and bad-weather operations. Although this feature has been touted in many articles, there are no photographs showing the upper halves retracted on either of the two XF-12 prototypes. This feature is believed to have been intended for the production aircraft. (G. Hildebrand via Author Collection)

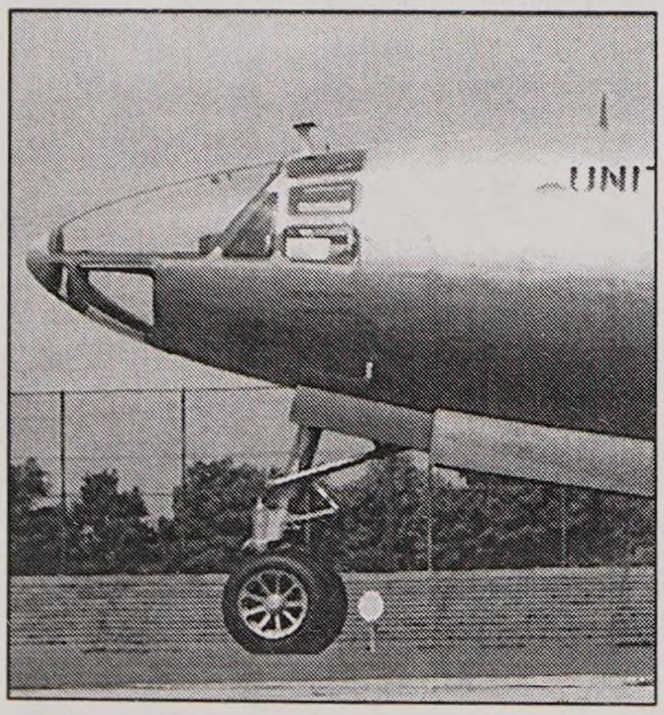
and horizontal stabilizers. The aircraft was constructed of high-strength Dural 75ST aluminum throughout. Its conical-shaped clear nose section was designed for optimum aerodynamic streamlining and to fully comply with USAAF requirement that the pilots have unrestricted 180-degree forward visibility. This nose section remains as one of the most distinctive designs of any multi-engine piston-powered airplane ever built.

Fuselage

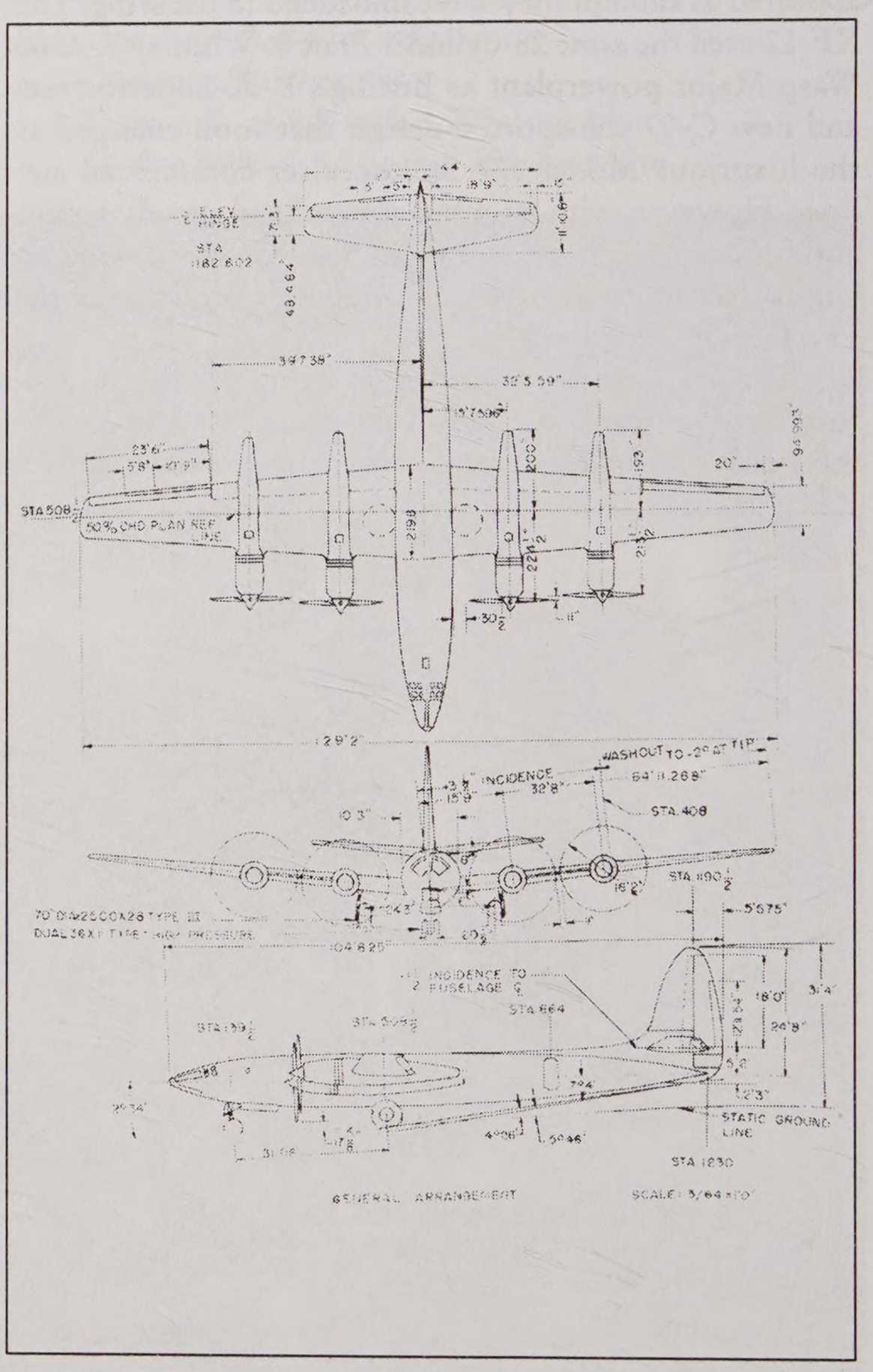
The XF-12's fuselage was designed to be an all-metal, semi-monocoque construction, and was tapered from nose to tail with no constant, or barrel, section. Had there been a need to significantly lengthen the airplane for future mission adaptability, the fuselage taper would have been a factor, although a near-constant section "plug" being added amidships would have been feasible. Had it been built, this fuselage "stretch" would have been accomplished for the proposed RC-2 airliner version, an aircraft that was 5 feet longer than the military production aircraft. Measuring 93 feet 11 inches in length, the XF-12's fuselage was 123 inches in diameter at the maximum point of taper. Although inherent in the streamlining of the airframe, this tapered fuselage design would have resulted in a somewhat diminutive forward and aft cabin section in airliner use. This was especially noticeable when compared to larger Douglas and Boeing transports of that era, such as the DC-4 and Stratocruiser, both of which featured constant-section cabins from nose to tail.



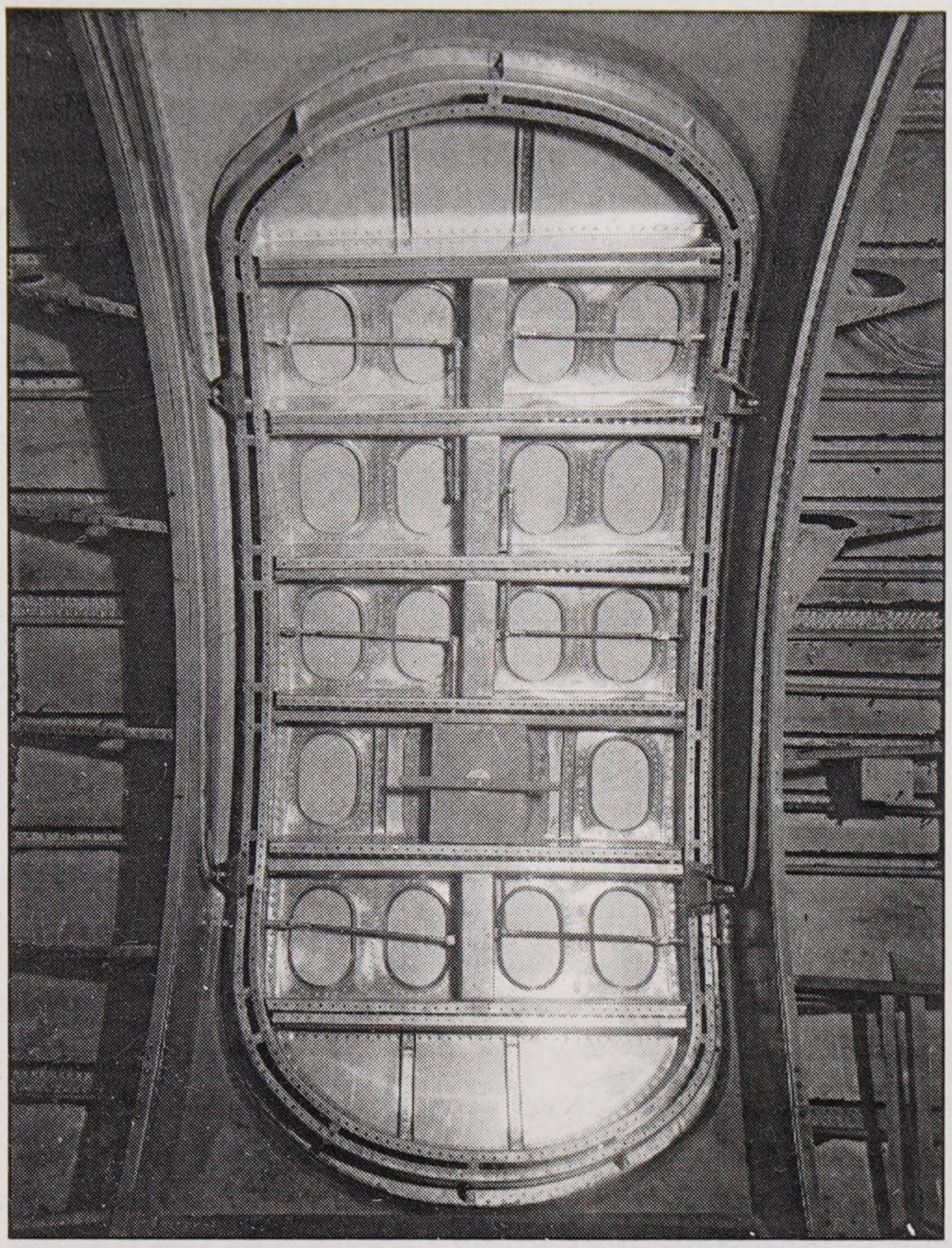
Photograph of co-pilot's clear-view window nicely illustrates the robust structural qualities necessary for pressurization of the cockpit and cabin. The XF-12 interior was pressurized to 10,000 feet at altitudes of up to 40,000 feet. This is the center right-hand cockpit window with its handles in the "open" position. Right-hand grip of co-pilot's control wheel can be seen at lower left. (G. Hildebrand via Author Collection)



Close-up of XF-12 nose section reveals how the drawings translated to actual structure on the airplane. Unlike robotic 3-D digital manufacturing today, 1940's methodology for design and construction included the use of 12-inch slide rules and chalked lofting lines to achieve the compound curvature seen here. Note how closely the window configuration was carried over from the initial concept drawing. (Author Collection)



The graceful lines of the XF-12 commercial airliner variant are captured in this original factory three-view drawing as seen in a technical report from the National Archives. The RC-2 Rainbow airliner would have had a fuselage that was 5 feet longer than the XF-12 ahead of the wing, changing the aircraft's proportions quite noticeably. (Courtesy of Tony Buttler)



Similarly robust interior structure was used for the main boarding door. While somewhat larger than standard entry doors seen on most military transport and bomber aircraft of that time period, this structure was designed with a passenger airliner variant in mind, even being located on the left-hand side of the aft fuselage. Note XF-12's robust interior structure and the basic T-handle mechanism at lower center of door assembly. (G. Hildebrand via Author Collection)

With a fineness ratio of 9:1, the XF-12's fully tapered profile shape was the epitome of aerodynamic cleanliness and efficiency. ("Fineness ratio" is defined as the relationship of fuselage length to its maximum diameter.) While a ratio of 4:1 is considered aerodynamically efficient, with higher numbers always being sought as more optimum, this value is also a factor of airspeed, meaning the higher the speed, the greater the ratio. The fuselage cross-section was perfectly circular throughout, also for maximum aerodynamic efficiency and optimum drag reduction at all intersecting structures such as wing and tailplane surfaces.

Cockpit, cabin, and below-main-deck compartments were pressurized to mean sea level at 10,000 feet, and were heated and pressurized to an ambient 10,000-foot altitude at 40,000-foot actual altitude. This gave the Rainbow's interior a pressure differential of 14.7psi, an impressive number for a large high-altitude airplane. The fuselage's pressure vessel extended from the flat windshield section of the cockpit aft to the main cabin rear bulkhead, and also included the below-main-deck compartments. The lower compartment containing 18 photographic flares for nighttime operations was shielded with thick anti-flack armor for optimum safety and protection.

Wing Design

With a span of 129 feet 2 inches and an area of 1,640 square feet, the XF-12's wing dominated the airplane's shape in plan view. Its mean aerodynamic chord (defined as the averaged distance from leading to trailing edge measured parallel to the line of flight) was 161.2 inches, and wing loading was 71 pounds per square foot. Both leading and trailing edges were perfectly straight from root to tip. The airplane's mid-wing configuration was chosen for maximum aerodynamic efficiency with a minimum need for fillets at the wing root, and the wing was mounted with a 6-degree dihedral.

A perfectly circular forged-aluminum, main-spar carry-through design was utilized in order to eliminate the intrusion of a wing box into the fuselage interior. There were two such structural assemblies—one for the forward main spar, and one for the aft "drag spar." (This same unique structural feature was employed 20 years later for the attachment of the center engine to the vertical stabilizer and fuselage of the McDonnell Douglas DC-10 wide-body jetliner.) To allow passage of crewmen through these cabin structures in the XF-12, or passengers in the RC-2, a doorway was cut into each forging much like the doorway in a ship's bulkhead. The openings measured 30 inches wide by 80 inches tall, with tops and bottoms rounded for structural integrity.

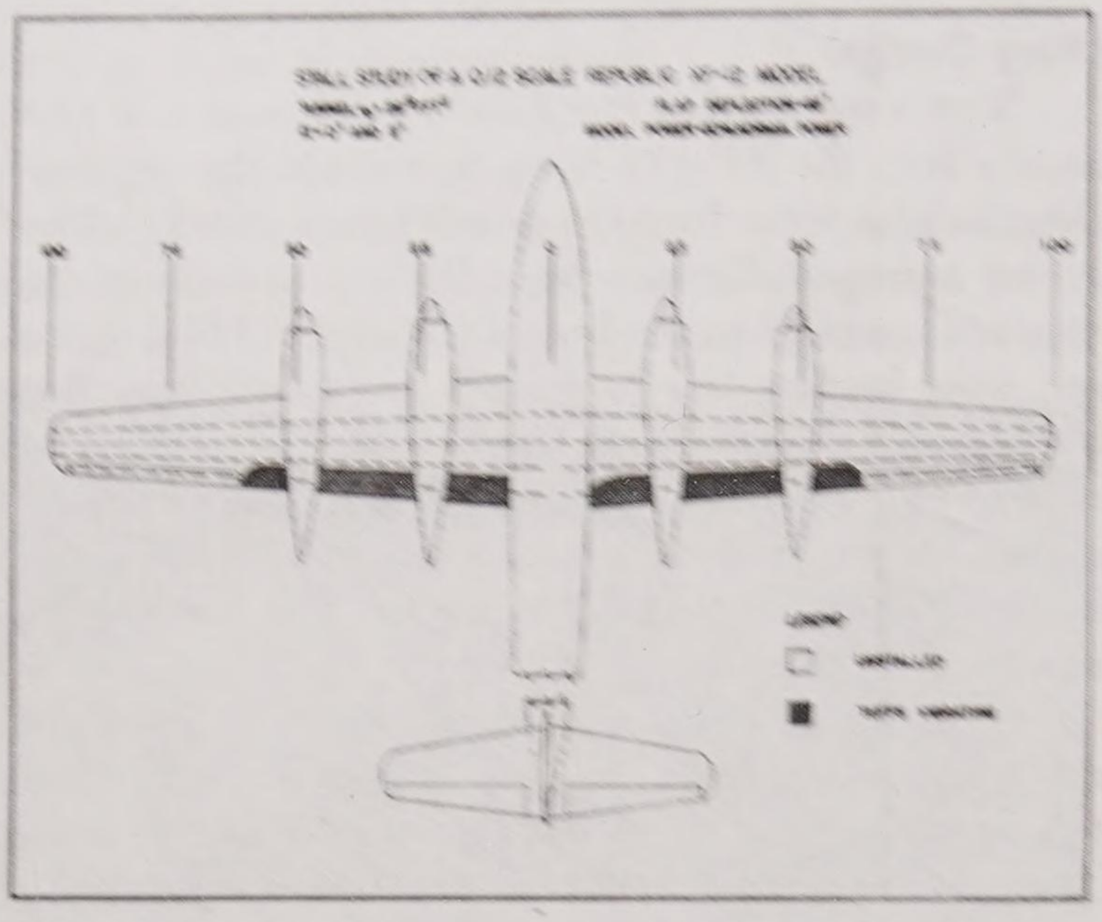
The XF-12's wing featured a high-aspect-ratio of 10:1, and was a laminar-flow design employing a Republic R-4 airfoil designed for flight operations at speeds in the range of Mach 0.7 (400 to 450 mph). The wing's maximum thickness of 17.5 percent at the root was determined by the dimension of the main landing gear wheels when retracted in their wells. Maximum thickness at the squared wingtip was 12 percent and the blunt (meaning not elliptical or rounded) wingtip design was chosen to afford the best possible stall characteristics.

Instead of using drag-inducing external air scoops for engine cooling, large streamlined air inlets perfectly integrated into the wing leading edge between the inboard and outboard engines were employed for that purpose. Ram air from these intakes was routed into the engine nacelles for oil cooling, and also fed the turbo-superchargers, intercoolers, and engine accessories. Measured pressure recovery of these inlets was 98 percent of ram air, or nearly aerodynamically perfect.

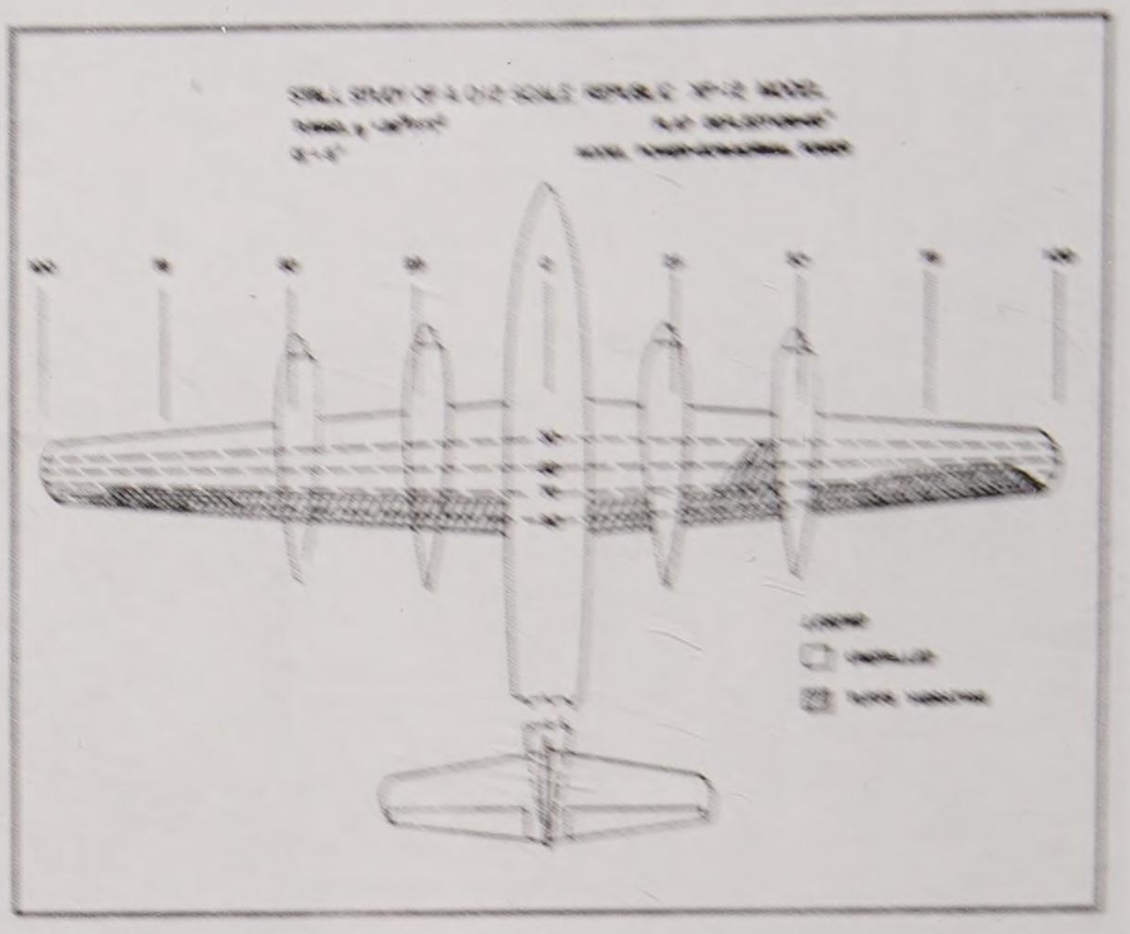
Double-slotted NACA Fowler flaps for enhanced stability at lower airspeeds were constructed in three separate sections extending across 60 percent of the aircraft's wingspan on the trailing edge. The long nacelle design provided the equivalent of "end-plate" aerodynamic

efficiency for optimum drag reduction when the flaps were fully extended. To avoid exceeding aircraft redline speeds, small "speed brake" flaps, similar to those used on late-model P-47s were mounted on the undersides of the wing just forward of the main spar. These small but highly effective flaps had a chord of 7 inches.

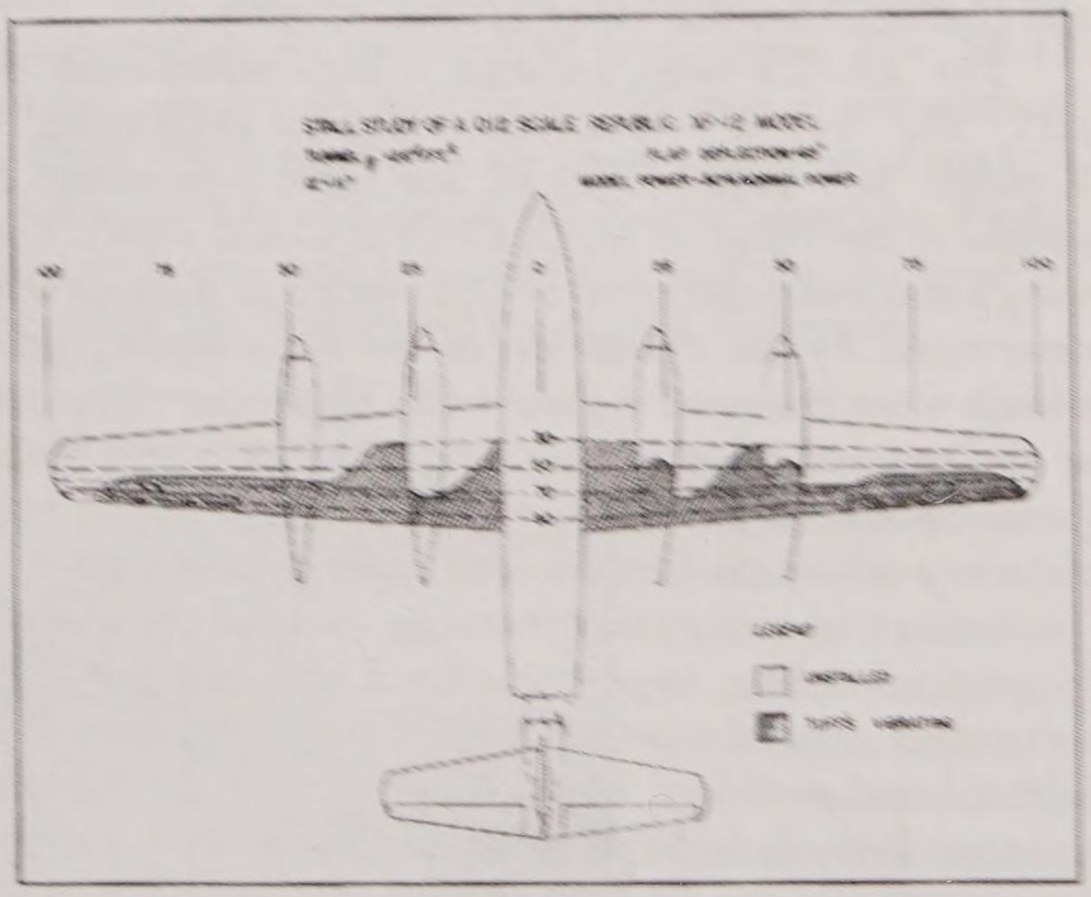
An innovative thermal anti-icing system was fed from a heat exchanger taking hot engine-exhaust bleed air and routing it internally through the wing leading edges, eliminating the need for drag-inducing external rubber de-icing boots. The XF-12's entire fuel capacity of 5,500 gallons was carried internally in both the wing



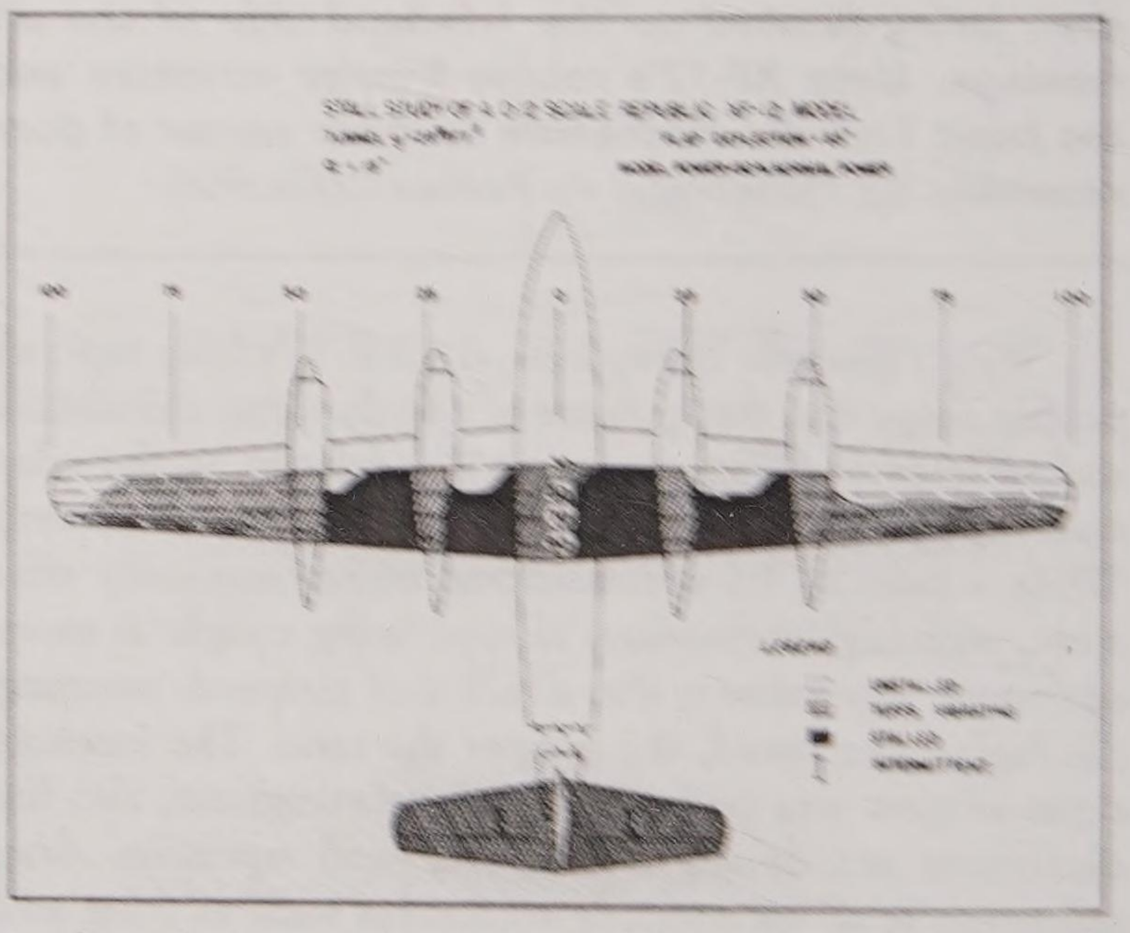
This sequence of diagrams shows the XF-12's stall properties resulting from its aerodynamic cleanliness and wing design, as verified by tuft testing on a 1/8-scale model "flown" in a wind tunnel. The wind tunnel model was configured at a 2-degree angle-of-attack with flaps deflected. The area in black shows the pattern of tuft vibration, but no portion of the wing is stalled at this point. (Cradle of Aviation Museum Archive)



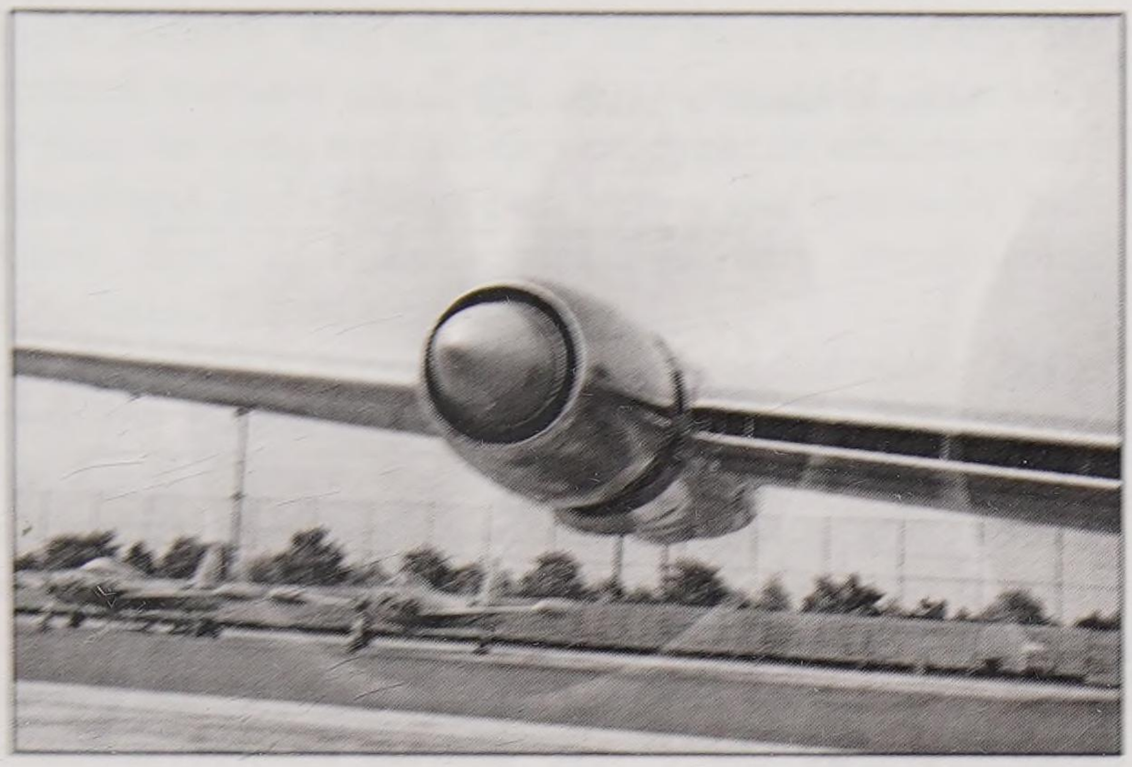
Now the angle-of-attack has been increased to 8 degrees, and the area of tuft vibration has extended span-wise out toward the wingtips, with the region of turbulent airflow propagating forward to the leading edge between engine nacelle number-three and -four. This is a good indication of the XF-12's low-speed handling characteristics with flaps extended. (Cradle of Aviation Museum Archive)



At 11 degrees angle-of-attack, the turbulent airflow begins to occupy a significant portion of the overall wing area, and is now expanding toward the leading edge among all four engines. Note that both wingtips are still in undisturbed air, showing that the ailerons are still maintaining control authority as the stall continues to propagate along the wing. (Cradle of Aviation Museum Archive)



As the wind tunnel model reaches an angle-of-attack of 13 degrees nose-high, airflow on the inboard trailing edge of the wing begins to separate and a large portion of the wing begins to stall. However, a considerable area of the outer wing remains unstalled at this point. Subsequent flight testing of the real airplane at Republic and Wright Field confirmed these findings. (Cradle of Aviation Museum Archive)



Ingenious system for reducing parasitic drag while still supplying needed ram air to various components of the engine, oil coolers, and turbo-superchargers is shown here. Within the XF-12's leading-edge air intakes, a series of multiple internal baffles duct the airflow where needed while the wing and engine nacelles remain free of any drag-producing external scoops or protuberances. (Cradle of Aviation Museum via Dennis R. Jenkins)

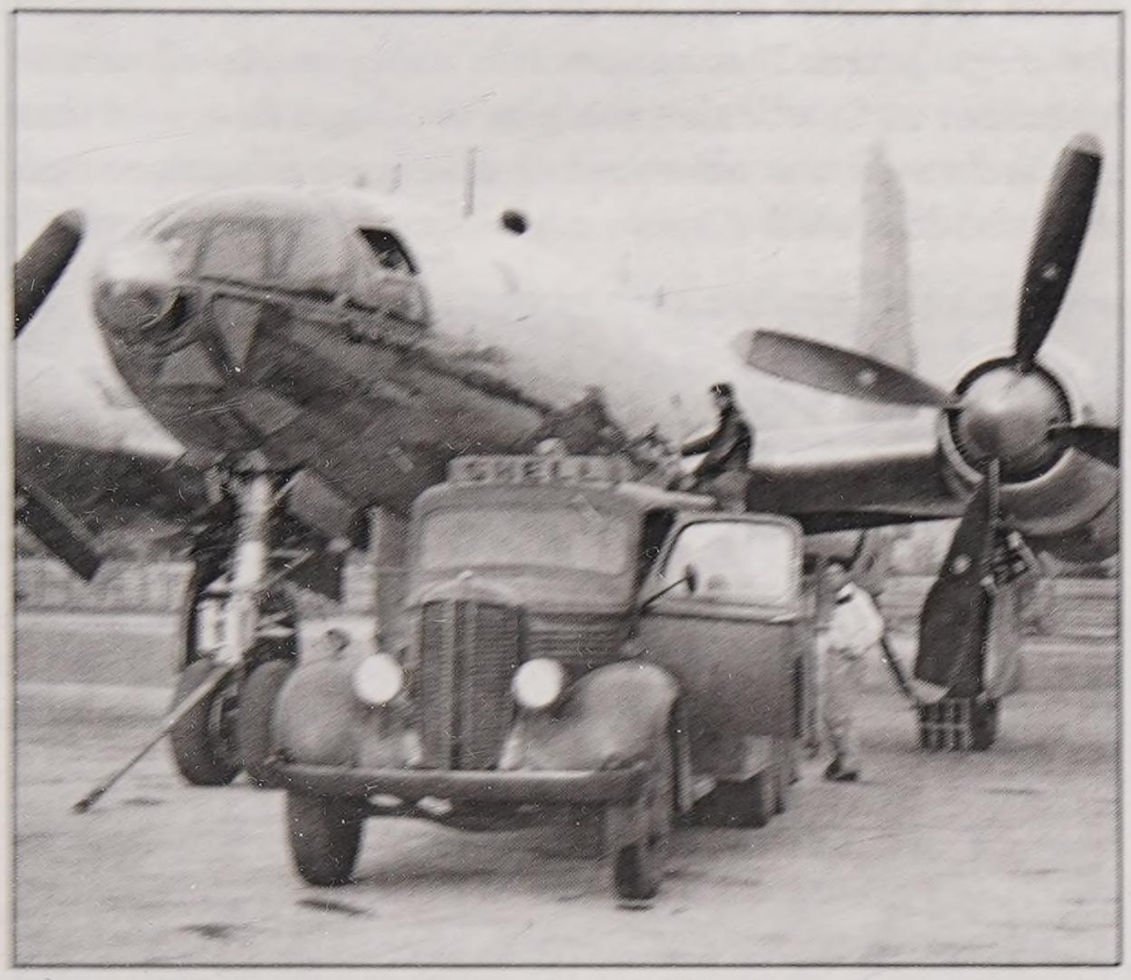
box structure (1,330 gallons) and the center wing and fuselage sections in self-sealing Marneg cells (4,170 gallons). The wing featured internally counterbalanced ailerons for optimum aerodynamic efficiency, and aileron hinge gaps were internally sealed as well.

Tailplanes

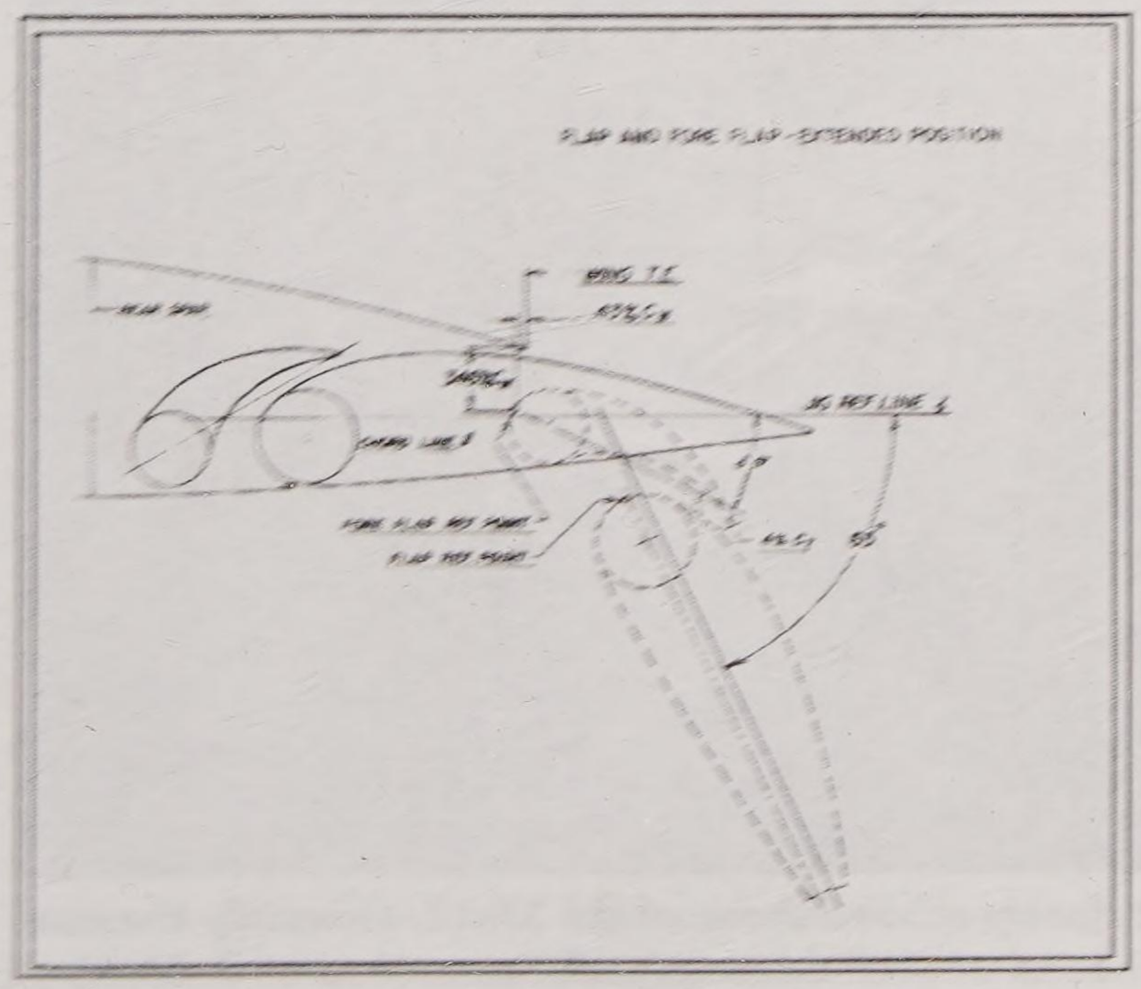
Horizontal stabilizers for the XF-12 had a span of 44 feet 0 inches, and an aspect ratio of 5:1, with straight leading and trailing edges, blunt (unrounded) tips, and the same 6-degree dihedral as the wing. The empennage was mounted at the base of the vertical stabilizer, but well above the fuselage centerline to avoid the effects of turbulent air in the wetted area behind the wing. Since wing wake increases in size, thickness, and severity as the airplane's Mach number increases during high-speed flight, it was imperative that the XF-12's horizontal stabilizers be mounted high enough above the fuselage to avoid severe buffeting at the airplane's cruising speed of 400 mph and top speed of 460 mph.

Elevators featured sealed internal counterbalances for optimum aerodynamic efficiency, and their hinge gaps were internally sealed as well. (Overall configuration was nearly identical to the F-84 Thunderjet in both profile and plan view.)

The XF-12's single gracefully tapered vertical fin was 28 feet 1.5 inches in height, and had an aspect ratio of 3:1. Rudder counterbalances were mounted internally, and internally heated leading-edge anti-icing mitigated the need for external rubber de-icer boots. Like the XF-12's other control surfaces, the rudder hinge gap was sealed



XF-12's advanced single-point refueling eliminated the need for any ground crew members to climb on top of the aircraft's wings to refuel it. Gas truck seen here is supplying the first XF-12 with high-octane avgas for its next mission. Note open center cockpit window. (Cradle of Aviation Museum Archive)

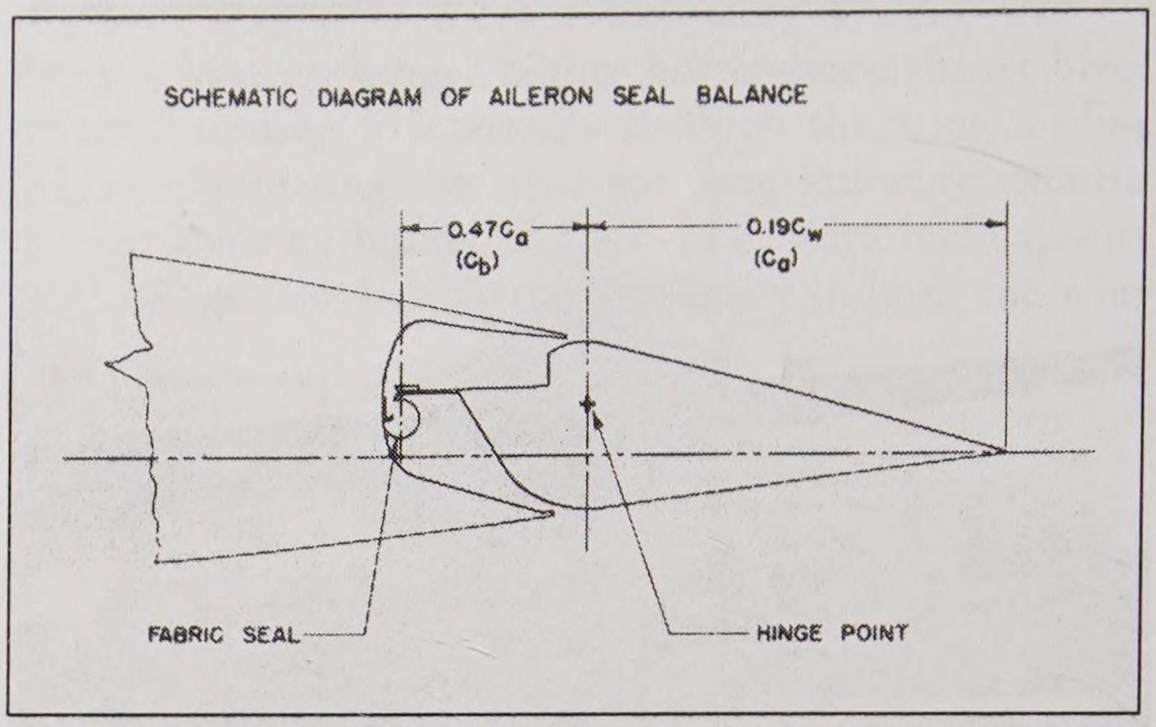


This technical illustration shows cross section of the double-slotted Fowler flap both retracted and extended to its maximum 65-degree position. Although the wing flaps are interrupted by the engine nacelles, the expected loss of airflow from the inboard and outboard edges of each flap surface is minimized by the "end-plate effect" of the nacelle walls themselves. Flaps extended outboard from the wing root to 60 percent of the XF-12's total 129-foot wingspan. (Cradle of Aviation Museum Archive)

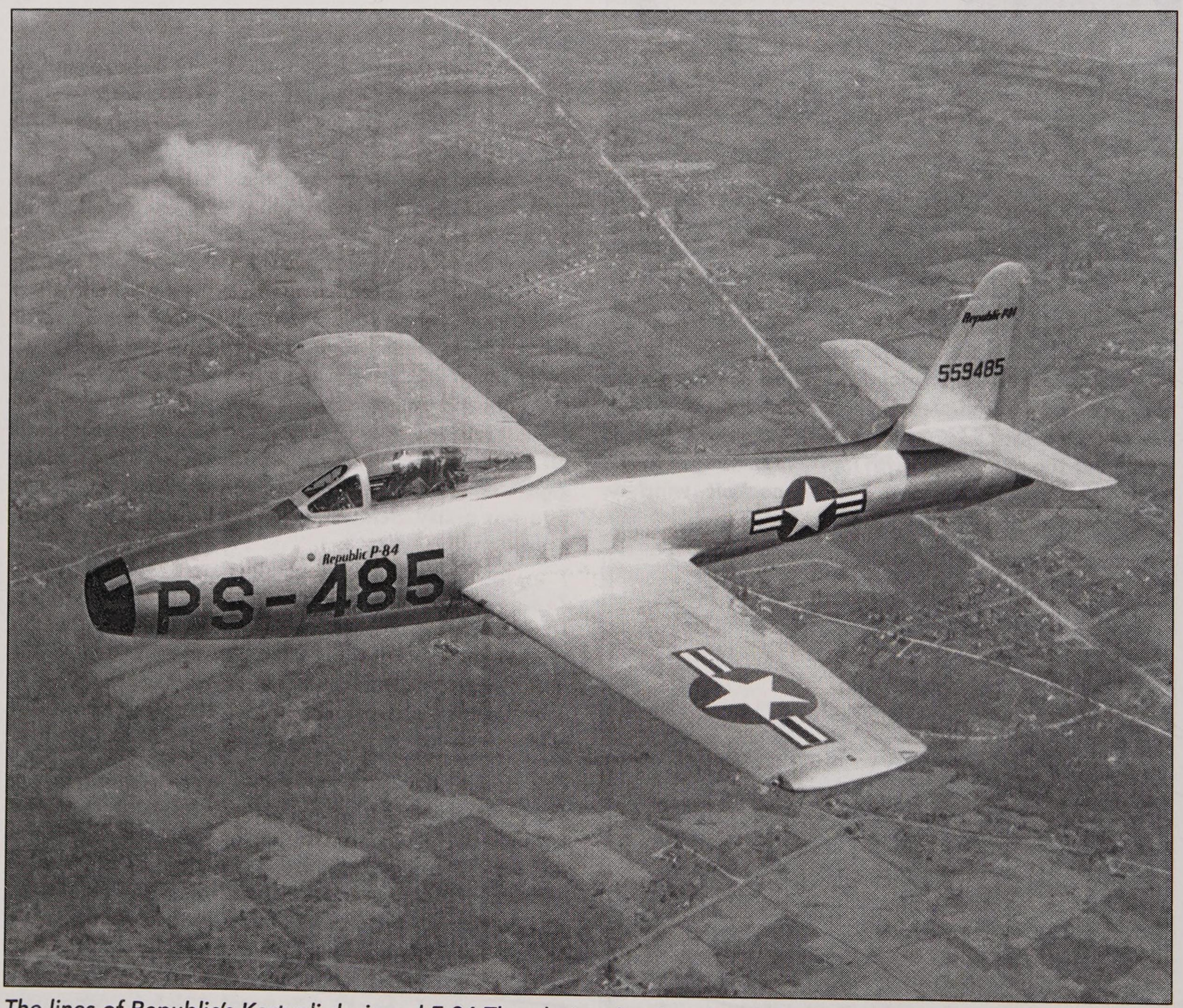
internally also. A stub ventral fin below the fuselage tailcone provided enhanced lateral stability at high angles-of-attack, and also housed a retractable tail bumper to protect the aft fuselage from damage in the event of an over-rotation on takeoff or landing.

Flight Control System

To eliminate the need for heavy and complex hydraulic systems to boost the XF-12's controls, Republic engineers designed a flight control system that used a combination of balance and trim tabs to move the larger control surfaces that maneuvered the airplane. These tabs were spring loaded to minimize the amount of physical force the pilots would need to use in handling the controls to maneuver the airplane. Additionally, as was learned in the design of Republic's World War II fighter aircraft, all moveable control surfaces were constructed using metal external skins, and not fabric, for greater safety and structural integrity at speeds above 300



Schematic diagram of the aileron control surface shows the fabric seal inside the wing and forward of the hinge point. This system was designed to eliminate turbulent airflow inside the aileron hinge line, and was applied to all the other moveable control surfaces on the XF-12 as well. (Cradle of Aviation Museum Archive)



The lines of Republic's Kartveli-designed F-84 Thunderjet closely echoed those of the XF-12, especially the contours of that aircraft's vertical fin and the location and dihedral of the horizontal stabilizers. (Author Collection)

mph. Balance weights, used for counterbalancing the control surfaces in flight, were mounted internally within the wing and tail for aerodynamic efficiency and cleanliness, and all hinge gaps were sealed internally with fabric tape, again to ensure maximum aerodynamic cleanliness and efficiency.

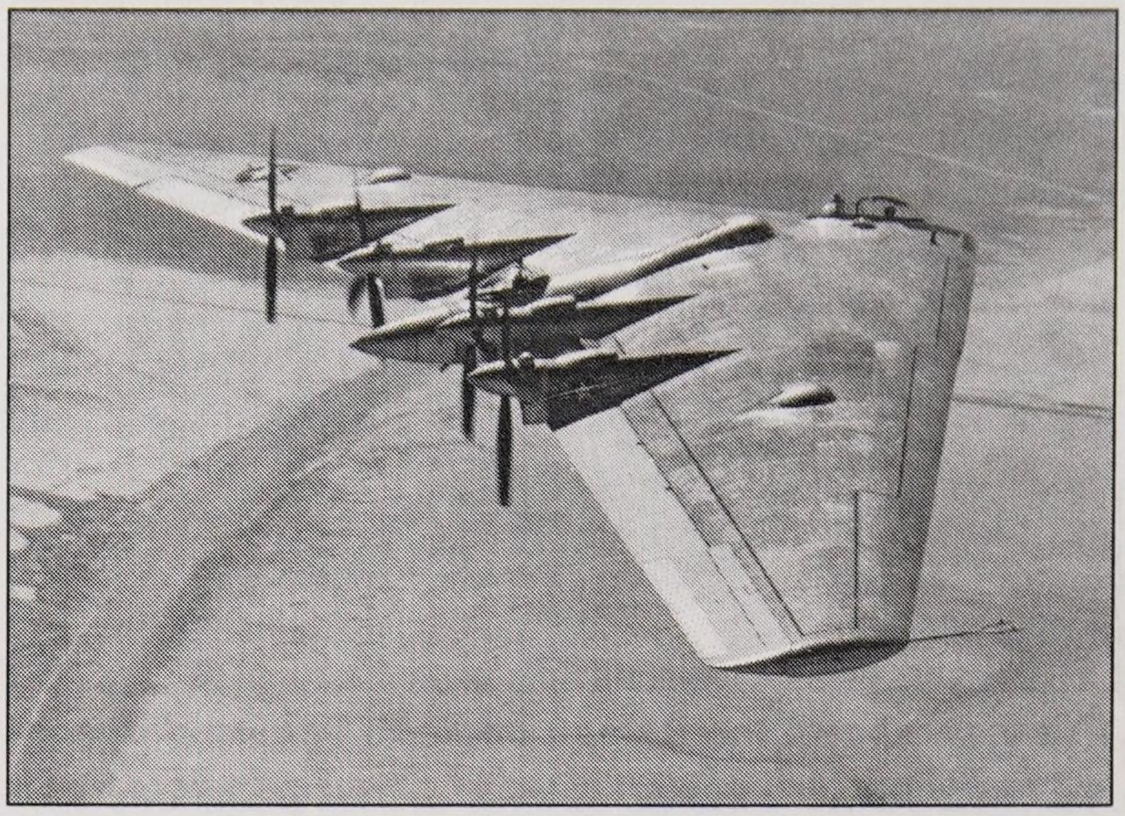
Republic's experience in high-performance flight with the P-47 also proved that at high Mach numbers, sudden changes in the amount of required control balance could occur with consequent buffeting and, in some cases, ultimate loss of control. During large control deflections at high speed, severe accelerated stalls and aerodynamic "locking" could occur also. It was for these reasons that the XF-12's aerodynamic controls were designed as described above.

Aside from the fact that airplanes with hydraulically boosted control surfaces can become difficult or impossible to control if the multiple hydraulic systems fail completely, Republic designed the XF-12 with a system of spring-tab-equipped control surfaces that were moved by the use of smaller balance and trim tabs located on the trailing edges of the respective control surfaces. As a further refinement of this approach to designing a manually operated flight control system, the spring tabs on the XF-12 were "pre-loaded" so that the control tabs would not deflect until a given force was exceeded as the pilots moved the control wheel or rudder pedals. This pre-loaded force could also be varied for different flight regimens.

Powerplants

The mighty Pratt & Whitney R-4360 28-cylinder Wasp Major radial engine, the largest and most powerful mass-produced reciprocating engine ever built, was specified in the U. S. Army Air Forces' contract as the chosen powerplant for the XF-12. Capable of developing a maximum of 3,500 hp at 2,700 rpm at 40,000 feet, the R-4360 was an ample engine for giving the aircraft its proposed performance of 400-mph cruising speeds. Many different versions of the R-4360 were built for use on a wide variety of military aircraft including the Northrop XB-35 Flying Wing, Boeing C-97 and B-50, Douglas C-124 Globemaster, Fairchild C-119 Flying Boxcar, Martin JRM-2 Mars flying boat, and of course, the giant Convair B-36 Peacemaker. The version of the Wasp Major chosen for the XF-12 was the R-4360-31.

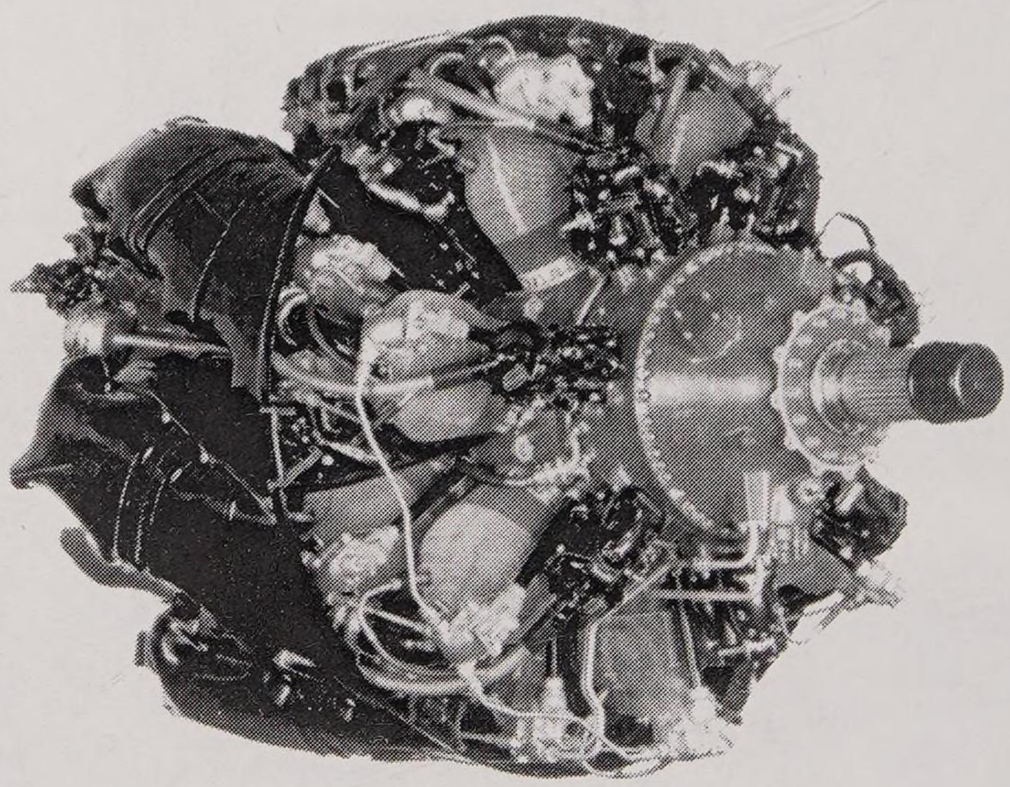
The R-4360 utilized water injection at takeoff to augment total available horsepower. Additionally, each engine's power was boosted inflight by two General Electric BM-4-5 turbo-superchargers that provided 10-percent total thrust augmentation (250 hp each engine) by venting exhaust gases through an ovaloid jet-like exhaust port at the extreme trailing edge of each nacelle. A more advanced version of the Wasp Major was also considered for use on the XF-12, but was never fitted to the airplane. Called VDT, for Variable Discharge Turbine, this variant replaced the standard R-4360's twin turbo-superchargers with a system of



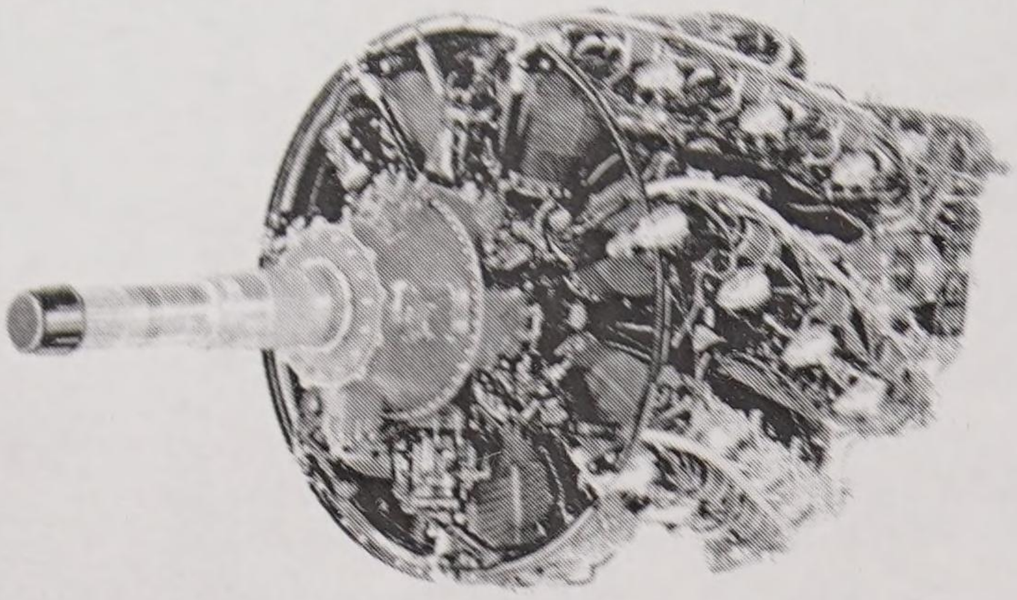
Another R-4360–powered aircraft was the futuristic Northrop XB-35 Flying Wing bomber. With its four Wasp Majors buried deep inside the massive wing, the airframe gave the illusion of having much sleeker engine nacelles. Elongated structures at the wing's trailing edge were actually aerodynamic fairings covering the contra-rotating propeller shafts. (Cradle of Aviation Museum via Dennis R. Jenkins)

larger turbine units that initially cooled and rerouted engine exhaust gases back into the piston engine for increased horsepower, and then boosted hot exhaust gases out of the back of the nacelle for augmented thrust.

Unlike previous well-proven and ultra-reliable Pratt & Whitney piston engines such as the R-2000 and



Right front-three-quarter view of Pratt & Whitney's mighty 28-cylinder R-4360-31 Wasp Major, the engine used specifically for both the Republic XF-12 and the Hughes XF-11 aircraft. Republic PR copywriters were quoted as saying that one R-4360 produced enough power to fly 60 RC-3 Seabees! The Wasp Major was the world's most powerful reciprocating engine ever mass produced. (Pratt & Whitney courtesy of Graham White)



This view shows the R-4360 engine's unique descending radial pattern of four rows of seven cylinders each, a configuration that gave this engine its famous "corncob" nickname. Capable of producing up to 3,500 hp at 2,700 rpm at sea level, the R-4360 was adapted for used in a multitude of military and commercial aircraft built during the late 1940s and early 1950s. (Pratt & Whitney courtesy of Graham White)

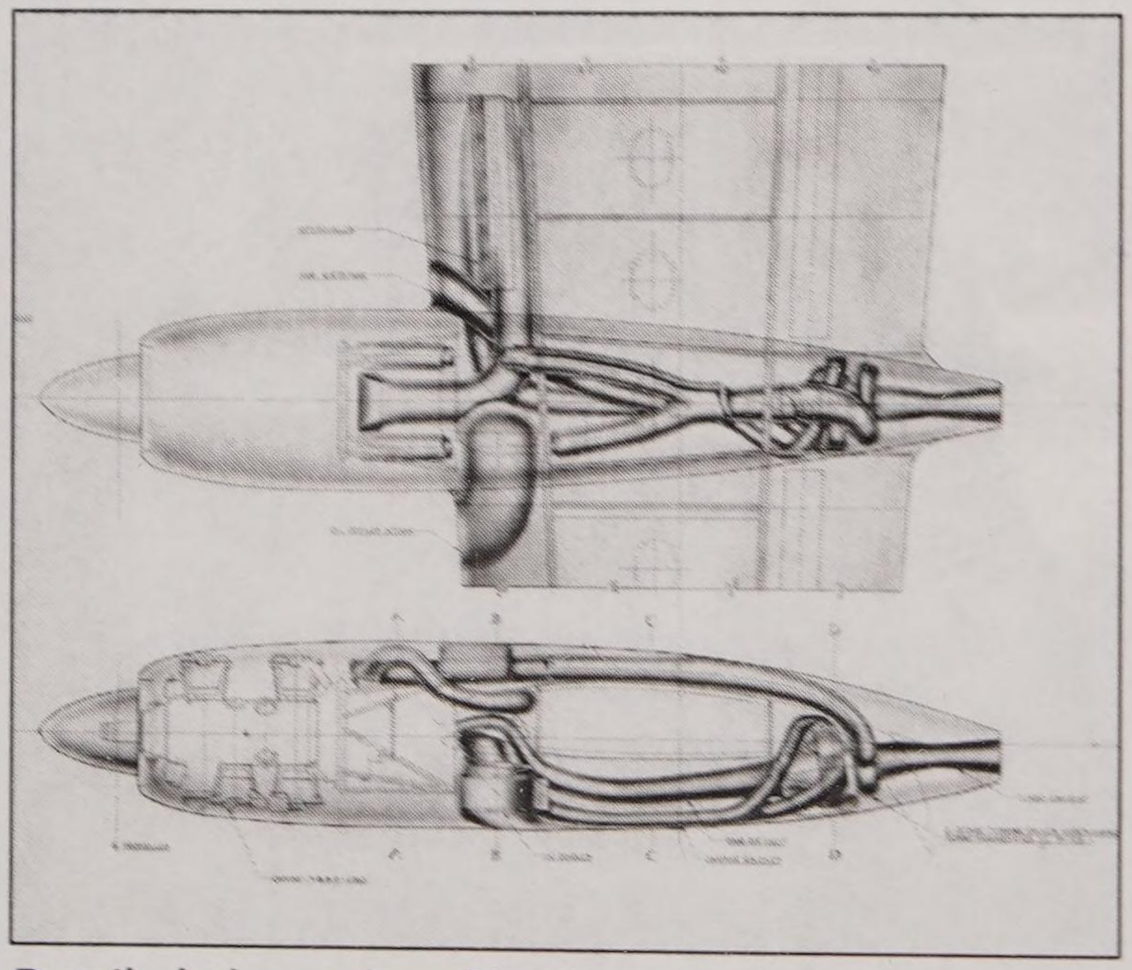
R-2800, the R-4360 could be very temperamental and very complex to operate, usually achieving only 1,000 hours TBO (time between overhaul). Although quite minimal in frontal area for such a powerful engine, the 28-cylinder configuration created inherent problems for cooling the aft-located cylinders. Identical R-4360-31 engines were also used on the competing Hughes XF-11 aircraft.

Engine Nacelles

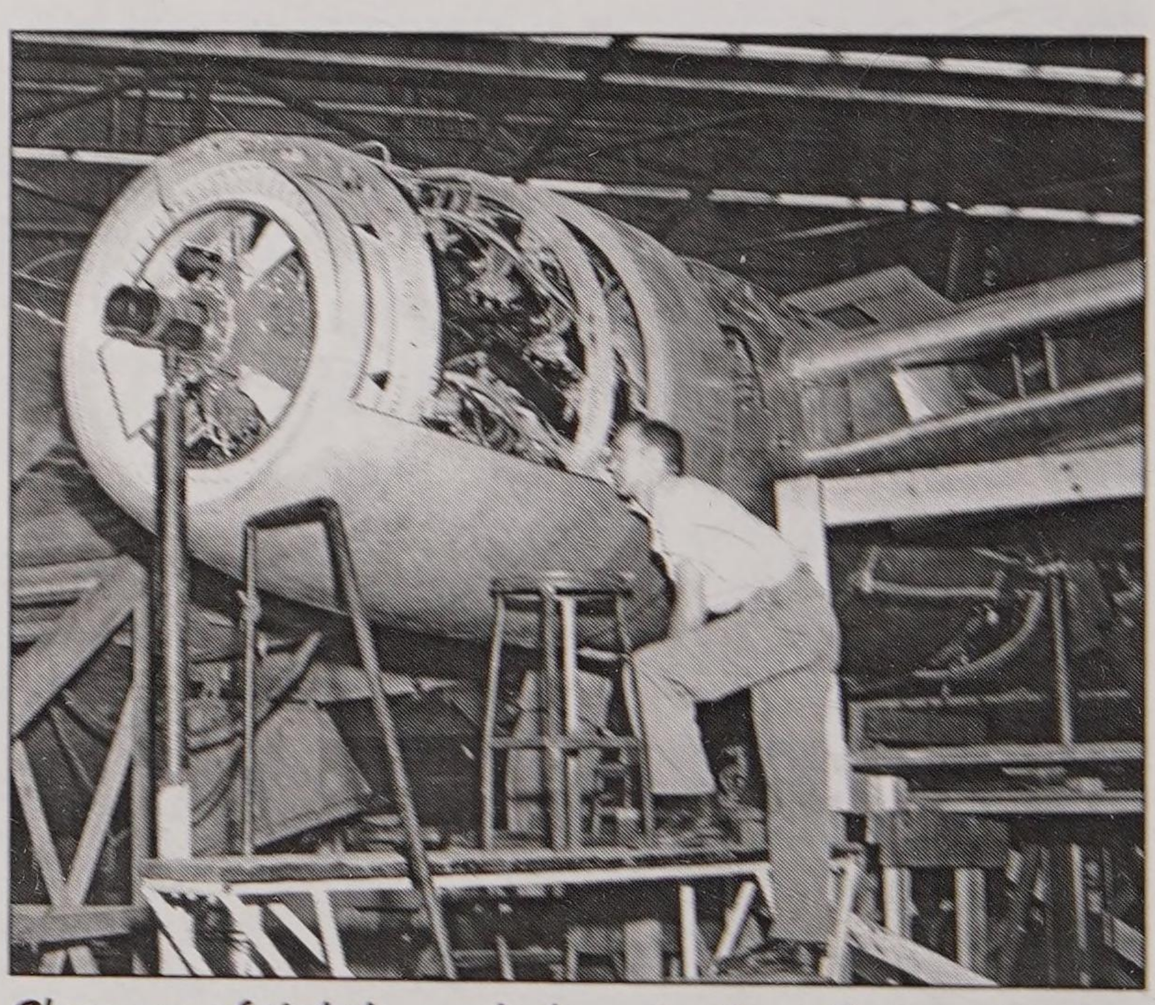
Unlike conventional piston-powered multi-engine aircraft that had their engine nacelles faired into the leading edge of the wing, the XF-12 featured torpedo-like nacelles that extended well forward and well aft of the wing leading and trailing edges. The aerodynamic and structural advantages of this design were many, including the complete absence of any drag-producing external scoops or protuberances extending into the airstream, minimal frontal area and cross-section, again for drag reduction, and abundant internal capacity for other mechanical components and systems to support engine performance such as superchargers and associated ducting.

Each engine nacelle on the XF-12 was approximately the length of a P-47 fuselage, with the inboard units measuring 35 feet 4 inches and the outboards being 33 feet 8 inches. (The P-47D measured 36 feet 1 inch.) Tightly cowled to its R-4360 engine, the forward nacelle featured a novel sliding-ring "low-pressure extractor" cowl flap to eliminate both structural complexity and aerodynamic drag while cooling the engines at appropriate power settings and altitudes. A significant advantage of this innovative design was that there were no drag-inducing external cowl flaps sticking out into the airstream during critical phases of slow-speed flight, such as immediately after takeoff or on final approach to landing.

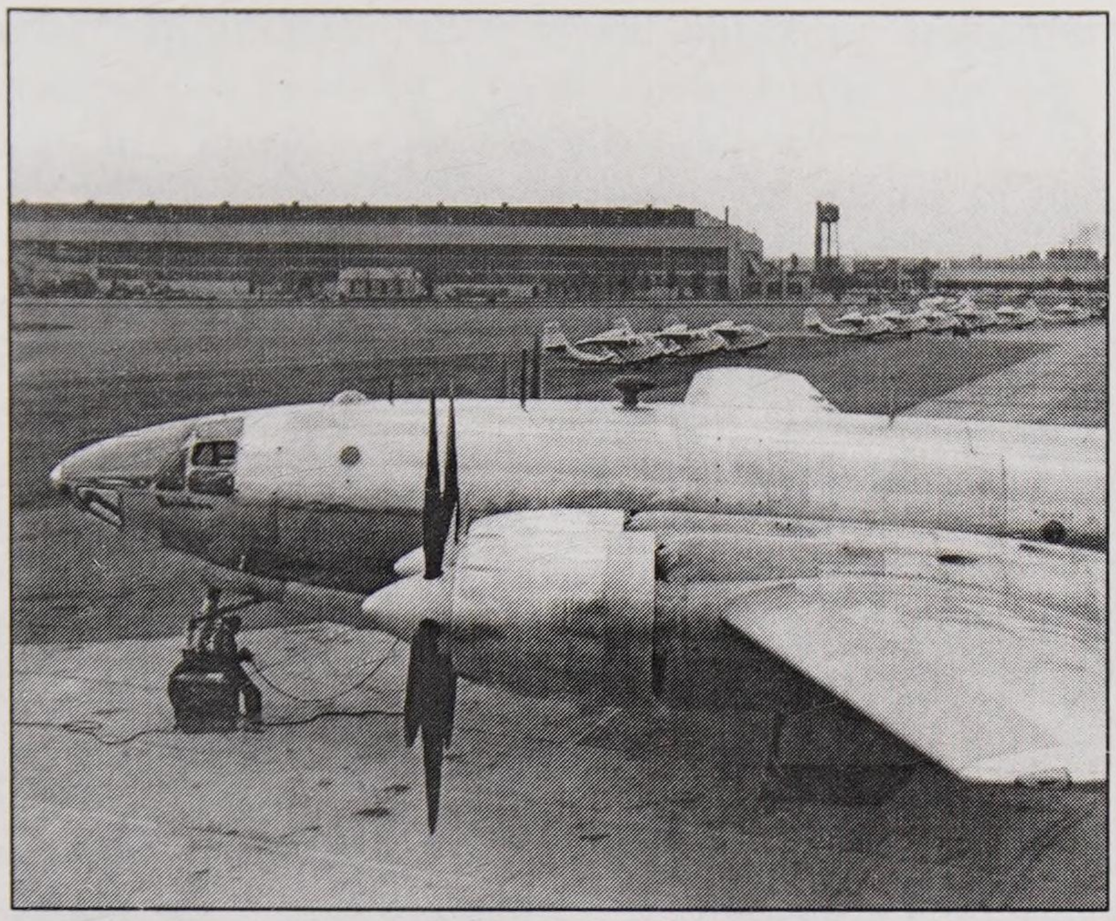
Located behind the propeller, a small-chord variable-speed-impeller engine-cooling fan was installed inside each nacelle at the forward face of the engine, directly aft of the propeller-spinner trailing edge. Exhaust ducts for the twin GE turbo-superchargers housed in the aft section



Detailed plan and profile views illustrate the complex serpentine plumbing involved in turbo-supercharging the XF-12's R-4360 engines. Twin General Electric BM-4-5 units provided an additional 250 hp per engine by venting their exhaust gases out the oval tailpipe of the nacelle—an equivalent 10-percent boost in overall engine thrust. (Cradle of Aviation Museum via Dennis R. Jenkins)



Close-up of tightly cowled engine installation showing the Pratt and Whitney R-4360 and its impeller cooling fan mounted at the leading edge of the nacelle. Impeller blades turned at two-and-a-half times the speed of the propeller. Person gives indication of the size of this powerplant, the world's largest mass-produced reciprocating engine. (Cradle of Aviation Museum via Dennis R. Jenkins)



Rare view looking down the left wing of the first XF-12 prototype reveals structural details of the upper engine nacelles and forward fuselage. A line-up of RC-3 Seabee amphibians can be seen in the background, denoting this photo as having been taken in early 1946. Note complete absence of black rubber de-icer boots on the XF-12's wing leading edge, as the need for these drag-producing devices was eliminated by the use of internal leading-edge heating from engine bleed air. This feature was quite advanced for an airraft built in 1946. (Cradle of Aviation Museum via Dennis R. Jenkins)

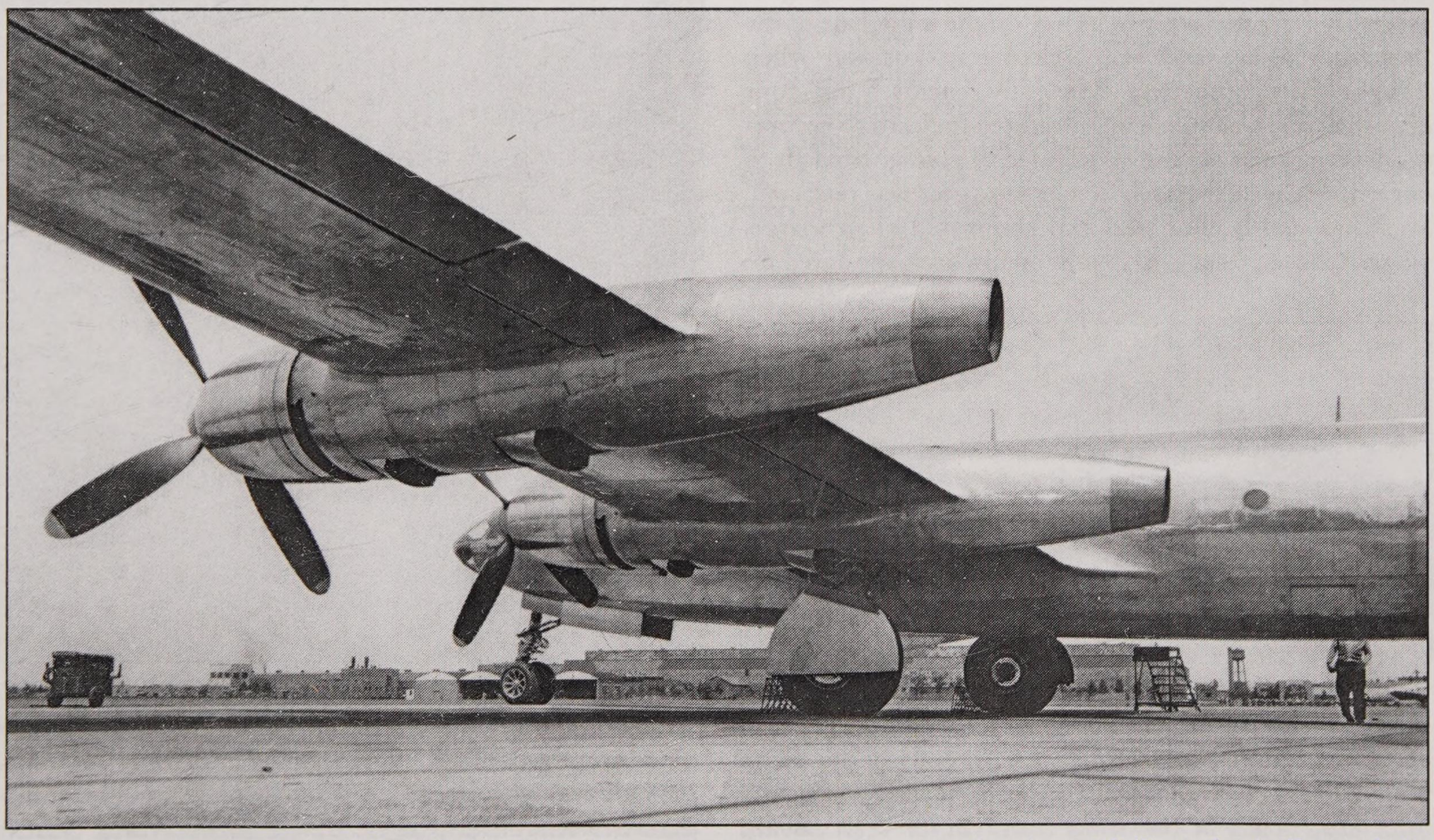
of each nacelle were mounted to the undersides of the nacelle body on the centerline, and in tandem. The trailing edge of each nacelle housed the exhaust duct for all other engine devices, configured as a clean elliptical opening situated 90 degrees to the aircraft's line of flight.

Propellers

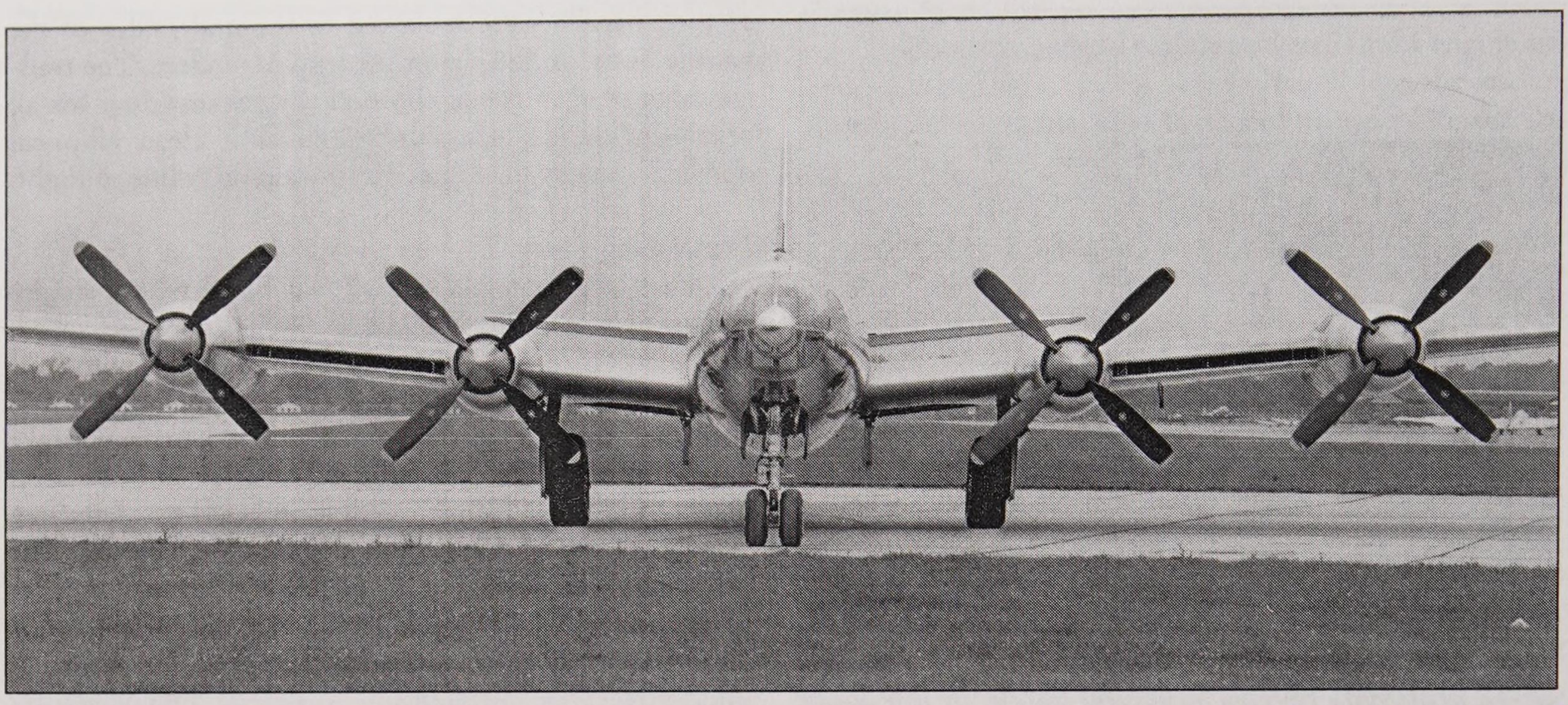
Each engine of the XF-12 was fitted with a single-rotation Curtiss Electric Model 644S-B constant-speed, fully feathering, and fully reversible propeller with four blades. Propeller diameter was 16 feet 2 inches. (Curtiss Electric was a division of the Curtiss-Wright Corporation.) The propellers featured hollow steel blades, and were fully reversible in pitch for achieving the shortest possible rollout distance on landing. The propellers were linked to the engine cooling-fan impeller blades and were configured for driving the cooling fan at 2.223 times faster than the propeller speed, but propeller pitch-governing mechanisms operated independently from engine lubricating oils, and were unaffected by temperature extremes at high altitudes. Continuous propeller synchronization was controlled automatically by Curtiss-designed units.

Landing Gear

The XF-12 featured a fully retractable tricycle landing gear. The nose landing gear was comprised of twin 3-foot-diameter nose wheels mounted on an axle below a single



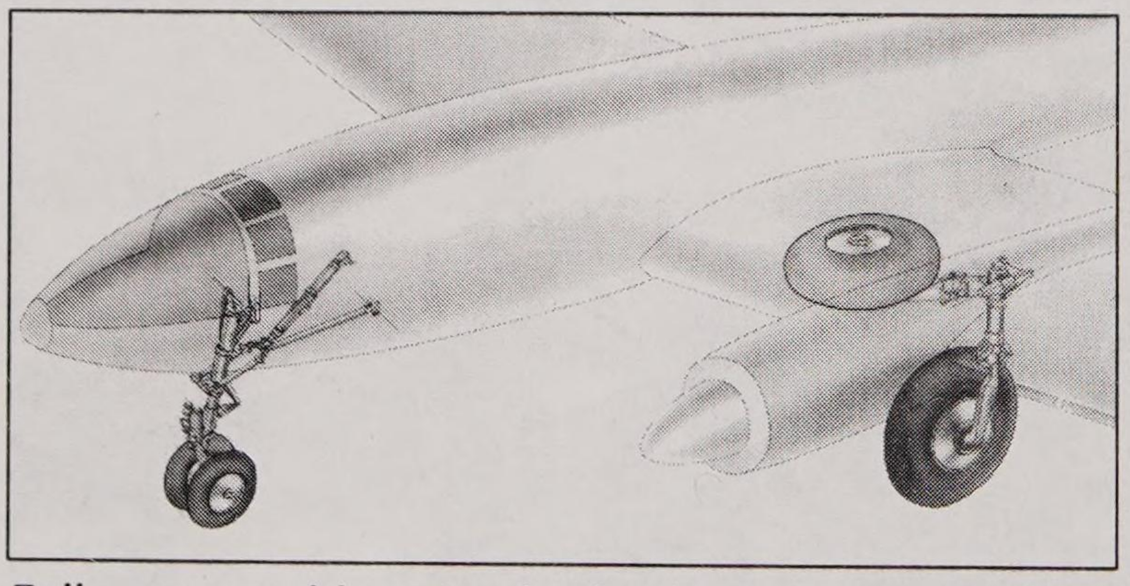
Dramatic ant's-eye view of the XF-12's left wing and engine nacelles reveals a beautifully crafted all-metal airplane that looked years ahead of its time in 1946. "Sugar scoop" extractor vents at bottom of nacelles were waste gates for the engines' twin turbo-superchargers, and were derived from similar vents used on the P-47. (Cradle of Aviation Museum via Dennis R. Jenkins)



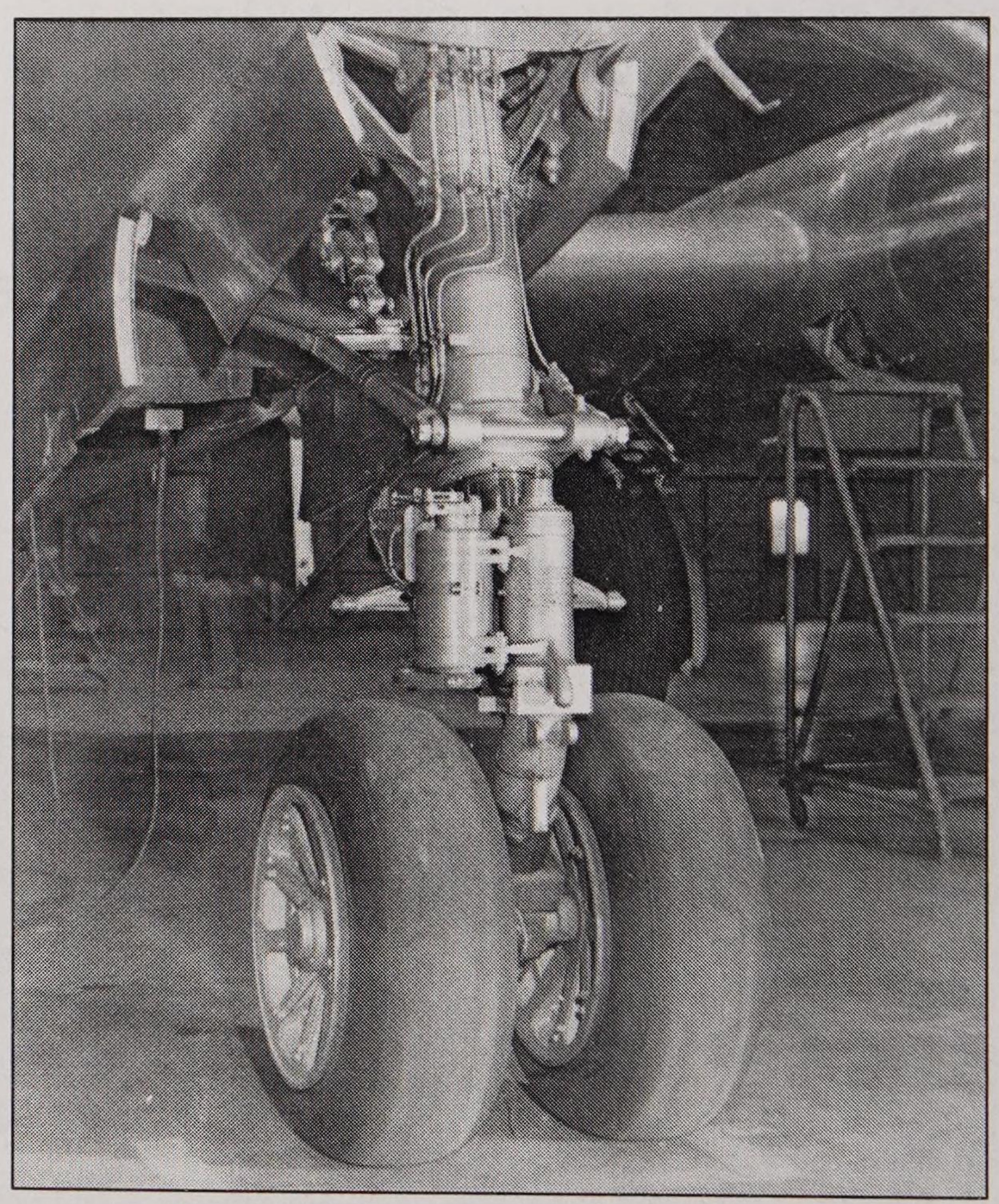
The diameter of the XF-12's massive Curtiss Electric propellers (16 feet 2 inches) is evident in this front view of the airplane taken at Wright Field in late 1947. While turning, the propellers on each wing had a separation of 9 inches between their tips. The constant-speed propellers were built with hollow steel blades, and were full-feathering and fully reversible. (Cradle of Aviation Museum via Dennis R. Jenkins)

long strut emanating from the underside of the fuselage directly below the cockpit. Vertical shock absorption was accomplished by the use of a single oleo-and-scissor oil-filled-piston shock absorber. This landing gear assembly retracted aft into its bay on the underside of the forward fuselage and was locked into position when inflight. The nose gear was fully enclosed by four clamshell doors, a smaller pair located forward to accommodate the strut assembly and a larger pair situated aft to cover the wheels themselves when the gear was retracted.

The main landing gear was comprised of two large, single, 5-foot 10-inch-diameter mainwheels mounted on



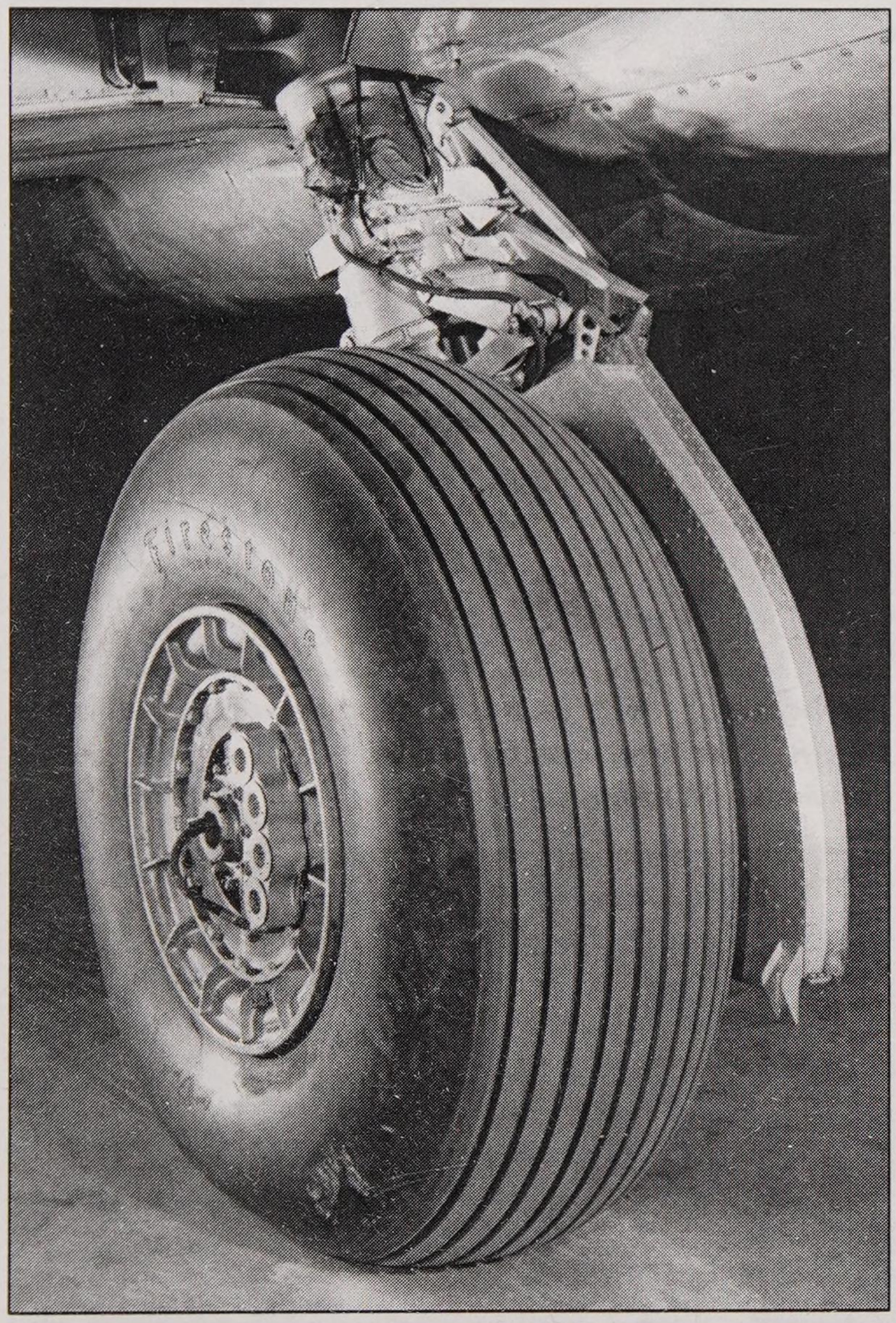
Fully retractable tricycle landing gear combined design elements of previous Republic (and Seversky) airplanes with a new twin nose wheel. Single large main wheels were chosen in order to have them retract into large wells in the wing root, rather than having smaller-diameter twin wheels with drag-inducing main landing gear fairings placed under the inboard engine nacelles. (Cradle of Aviation Museum via Dennis R. Jenkins)



Close-up of the XF-12 nose gear showing its twin 3-foot-diameter wheels mounted on a single, long, oleo-equipped strut. Note smaller forward landing gear doors, with larger ones located aft to accommodate the wheels and tires. Unlike some World War II bombers that allowed crew access to the cockpit through the nose wheel well, there was no such provision in the XF-12. (Cradle of Aviation Museum via Dennis R. Jenkins)

axles below single short struts emanating from the underside of the wing directly inboard of the number-two and number-three nacelles, respectively. Vertical shock absorption on landing was accomplished by the use of a single oleo-and-scissor oil-filled-piston shock absorber. The wheels and struts retracted inboard into the underside of the wing roots, and were then fully enclosed by four-piece articulating landing gear doors mounted outboard of the strut and immediately below the wing root on the fuselage. This design and assembly was similar in concept to those of the P-47 and F-84 fighters designed by Republic. The track of the main landing gear tires was 24 feet 3 inches wide.

The decision to place the main landing gear assembly into the wing box near the root (as would be done with smaller fighter airplanes) was made primarily to allow the inboard nacelles to be designed to match the outboard nacelles as closely as possible for minimal frontal area and resultant aerodynamic cleanliness. With the aircraft's main wheels housed tightly in the wing roots, the XF-12's inboard nacelles were free from having to house large mainwheel wells in bulky underside fairings, as was done on other contemporary four-engine transports and bombers of that era.



Similar in design concept to the large, single, main landing gear used on the Consolidated B-36 and XC-99, the XF-12 featured main landing gear wheels of 5-foot 10-inch diameter. Although cumbersome from a size standpoint, the single main wheel offered a fairly low footprint weight, accommodating operations from asphalt strips or even unprepared fields if necessary in an emergency. (Cradle of Aviation Museum via Dennis R. Jenkins)

Operational Systems

In addition to the standard USAAF flight and engine-control instrumentation outfitted to the XF-12 cockpit, the airplane's long-range navigation and communications suite included the following equipment:

- SCR-274N High Frequency Radio and Command Set
- SCR-522 VHF Radio Set
- SCR-695 Radio Set
- AN/ARC-8 Liaison Radio Set
- AN/ARN-7 Radio Compass
- Radio Localizer Receiver
- AN/ARN-5 Glide Path Receiver
- RC-193A Marker Beacon Receiver
- Radio Altimeter
- SCR-695 IFF System
- AN/AIC Interphone

Photographic Systems

With a design philosophy quite different from that of the competing Hughes XF-11 airplane, the XF-12's onboard photographic laboratory included all facilities and materials for accomplishing complete photo processing of camera film while the aircraft was in flight. Its internal camera configuration was also completely interchangeable depending upon specific mission requirements. For ease of operation and optimum coordination of mission activities, a central in-cabin control station for all onboard cameras could be operated by a single crewman designated as the navigator/photographer, and seated next to the first camera housing in the forward cabin.

Original camera complement for the XF-12 included a floor-mounted forward fuselage station, which housed one downward-facing vertical Fairchild K-18 camera with a 6-inch-diameter lens. Immediately aft of that installation was a floor-mounted center fuselage station, which housed a set of two downward-facing split vertical Fairchild K-22 cameras with 12-inch-diameter lenses. Aft of the split vertical cameras was an aft-fuselage station, which housed a floor-mounted trimetrogon camera system comprised of a combination of three downward-facing Fairchild K-17B cameras with 6-inch lenses.

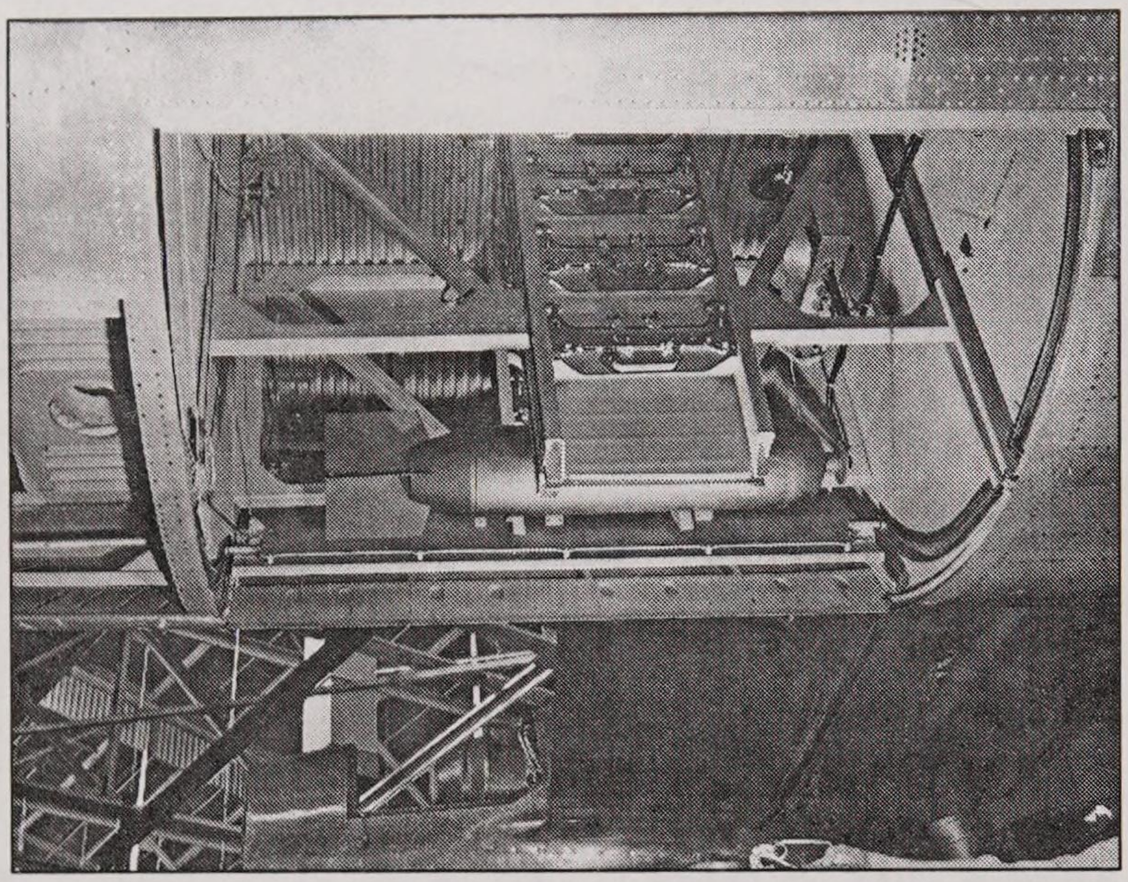
The XF-12's array of onboard camera system was augmented with the following support equipment:

- Type A-8 camera-mounting system, including all mounts and support equipment

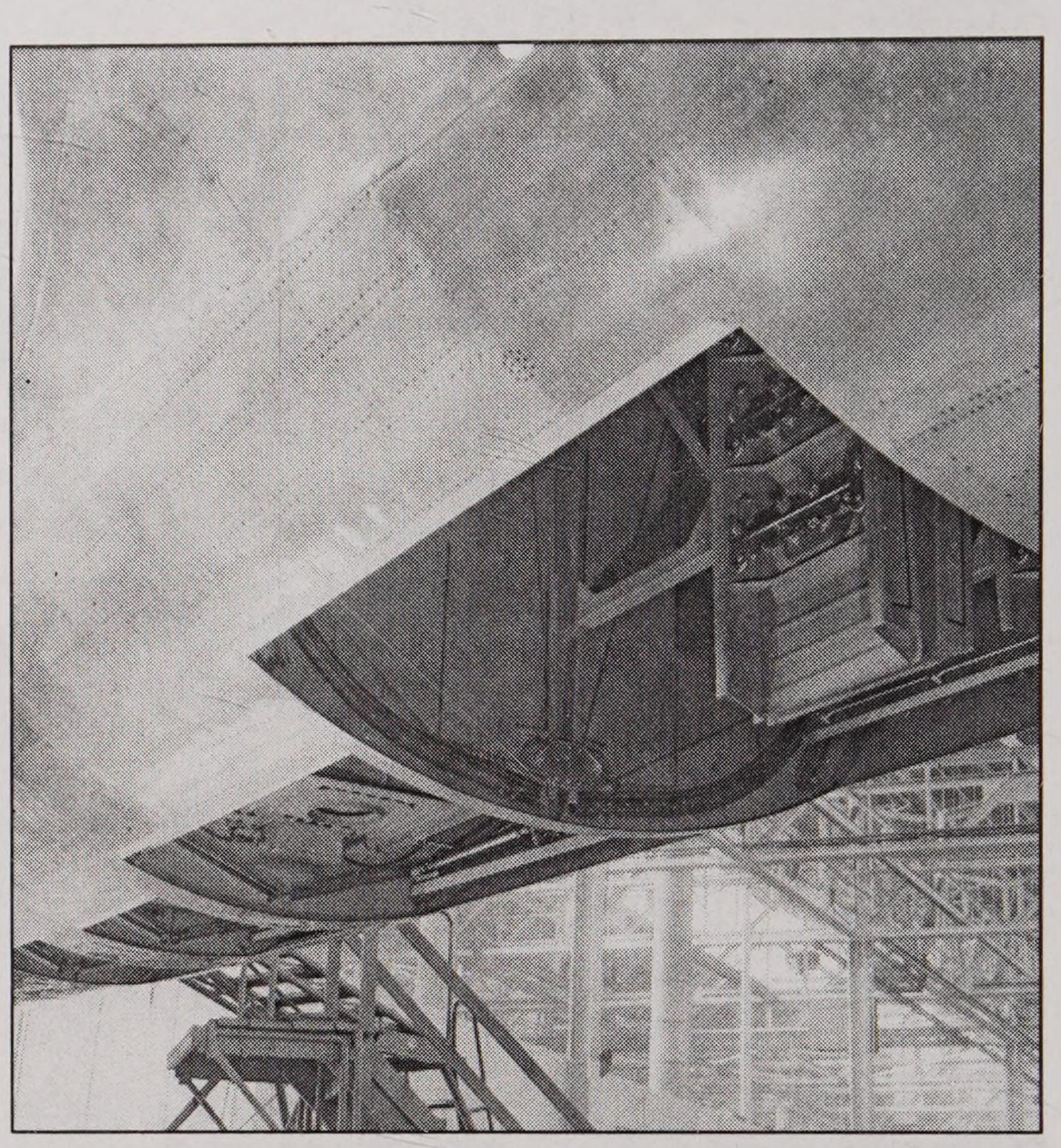
- Alternative type A-11 camera-mounting system, including mounts and support
- Type A-2 view finders
- Cone assemblies for the K-22 cameras
- Type A-8 film magazines
- Type A-9 film magazines
- Nine rolls of high-definition, 9.5-inch x 390-foot aerial camera film
- Multi-function camera controls
- Type B-3B intervalometer
- Type B-7 intervalometer

Alternative camera installations included:

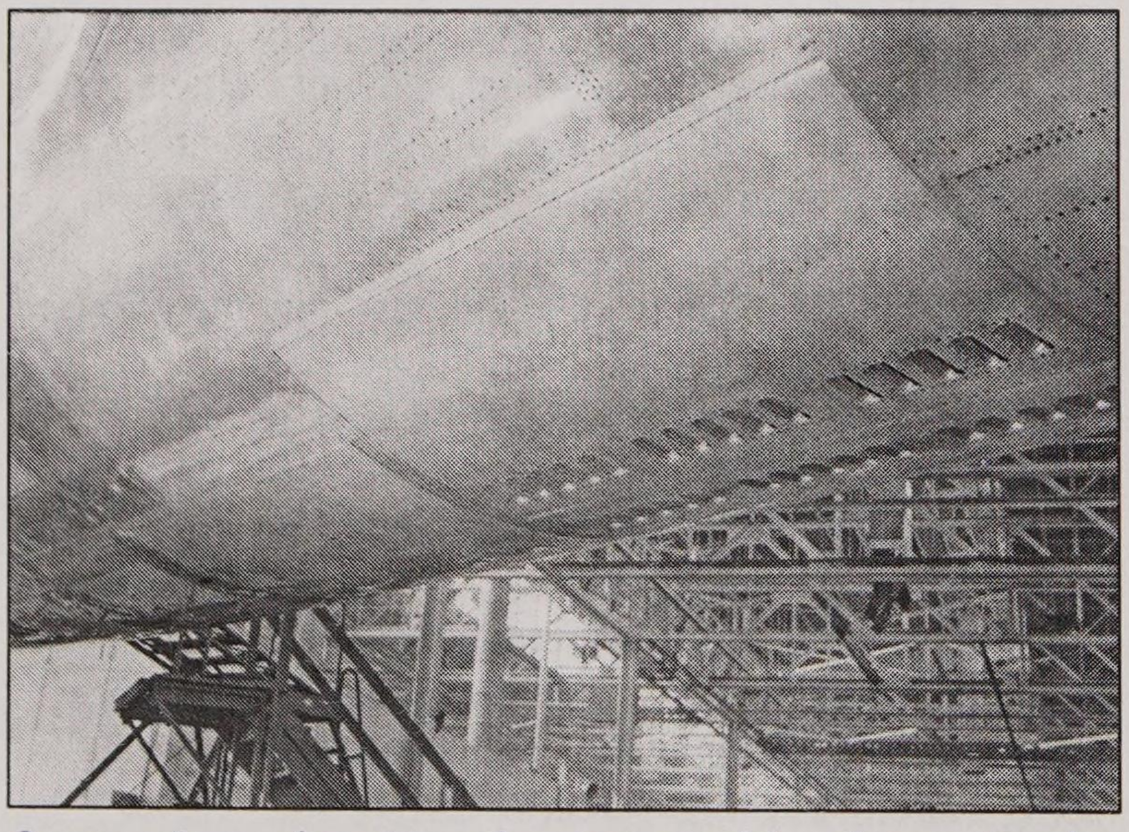
- Fairchild K-17 vertical camera with 12-inch lens
- Fairchild K-17 vertical camera with 24-inch lens
- Fairchild K-18 vertical camera with 12-inch lens
- Fairchild K-18 vertical camera with 24-inch lens
- Fairchild K-19 vertical camera with 12-inch lens
- Fairchild K-22 vertical camera with 6-inch lens
- Fairchild K-22 vertical camera with 12-inch lens
- Fairchild K-22 vertical camera with 24-inch lens
- Fairchild K-22 vertical camera with 40-inch lens



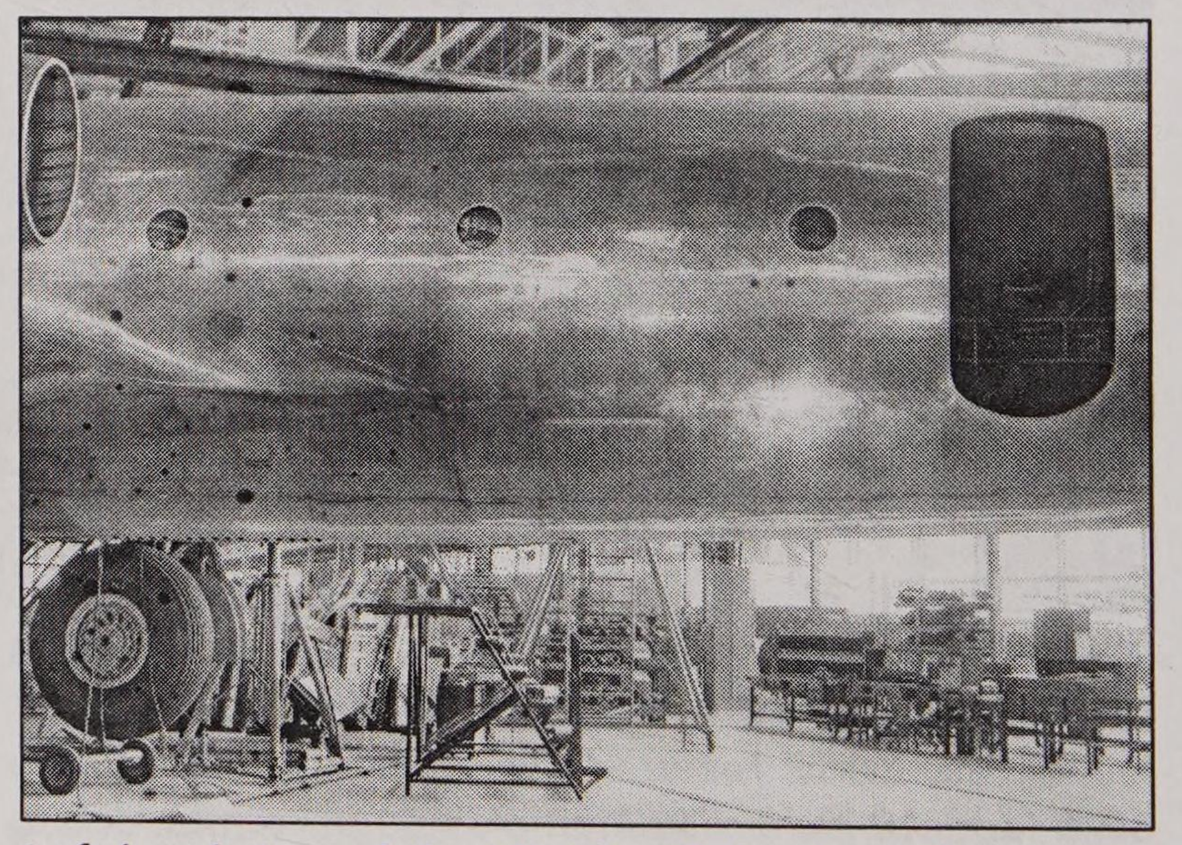
Close-up of the XF-12's bomb bay with doors open shows the racks for carrying 18 long-duration AN/M-46 flash bombs used for nighttime photographic operations. Flash bombs were carried nine-per-side on the rack shown at center. This compartment was fitted internally with heavy armor plating for optimum crew protection in potentially hostile reconnaissance environments. (Cradle of Aviation Museum via Dennis R. Jenkins)



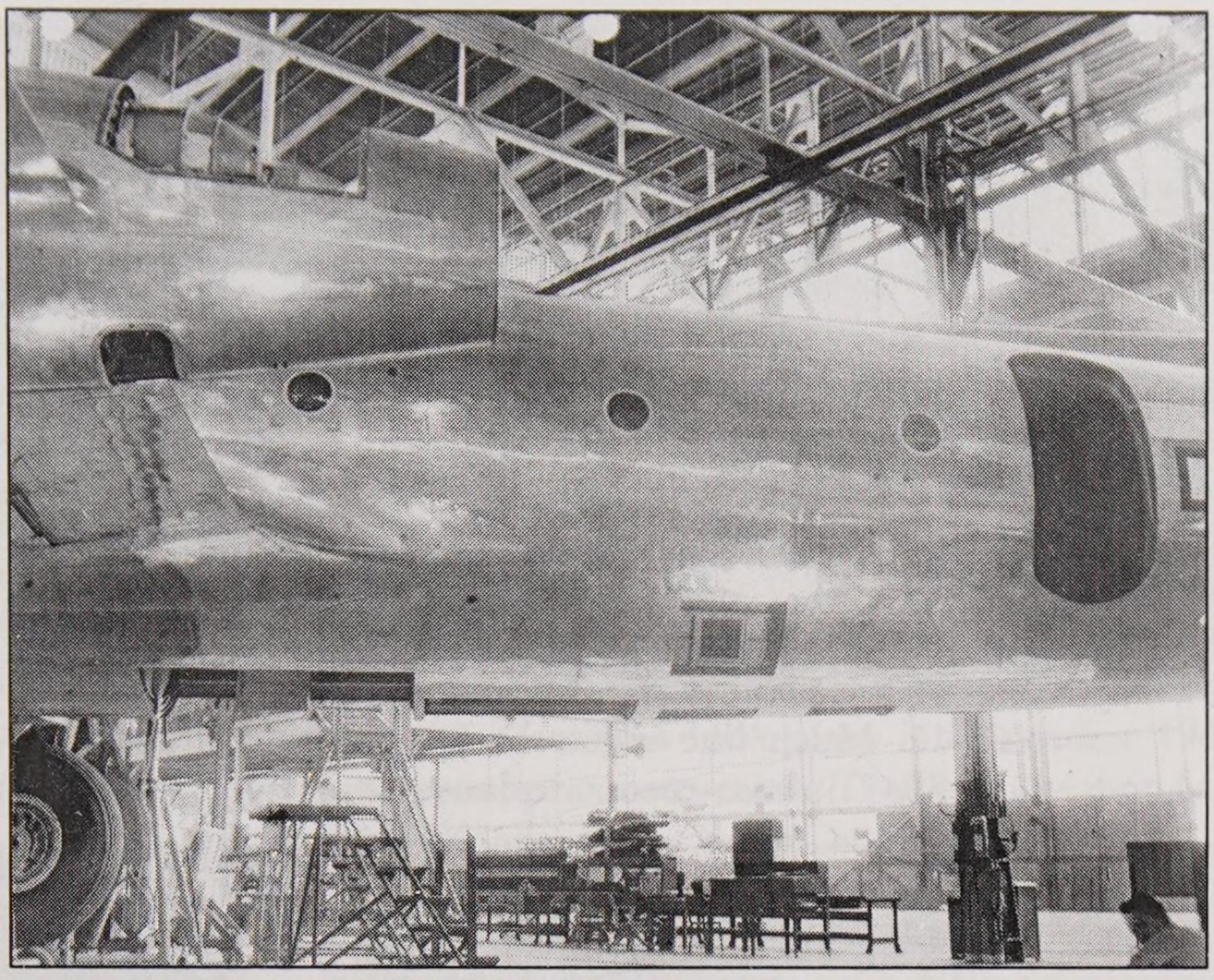
The bomb bay with its flush-fitting retractable doors is shown in the open position. View is looking aft. (Cradle of Aviation Museum via Dennis R. Jenkins)



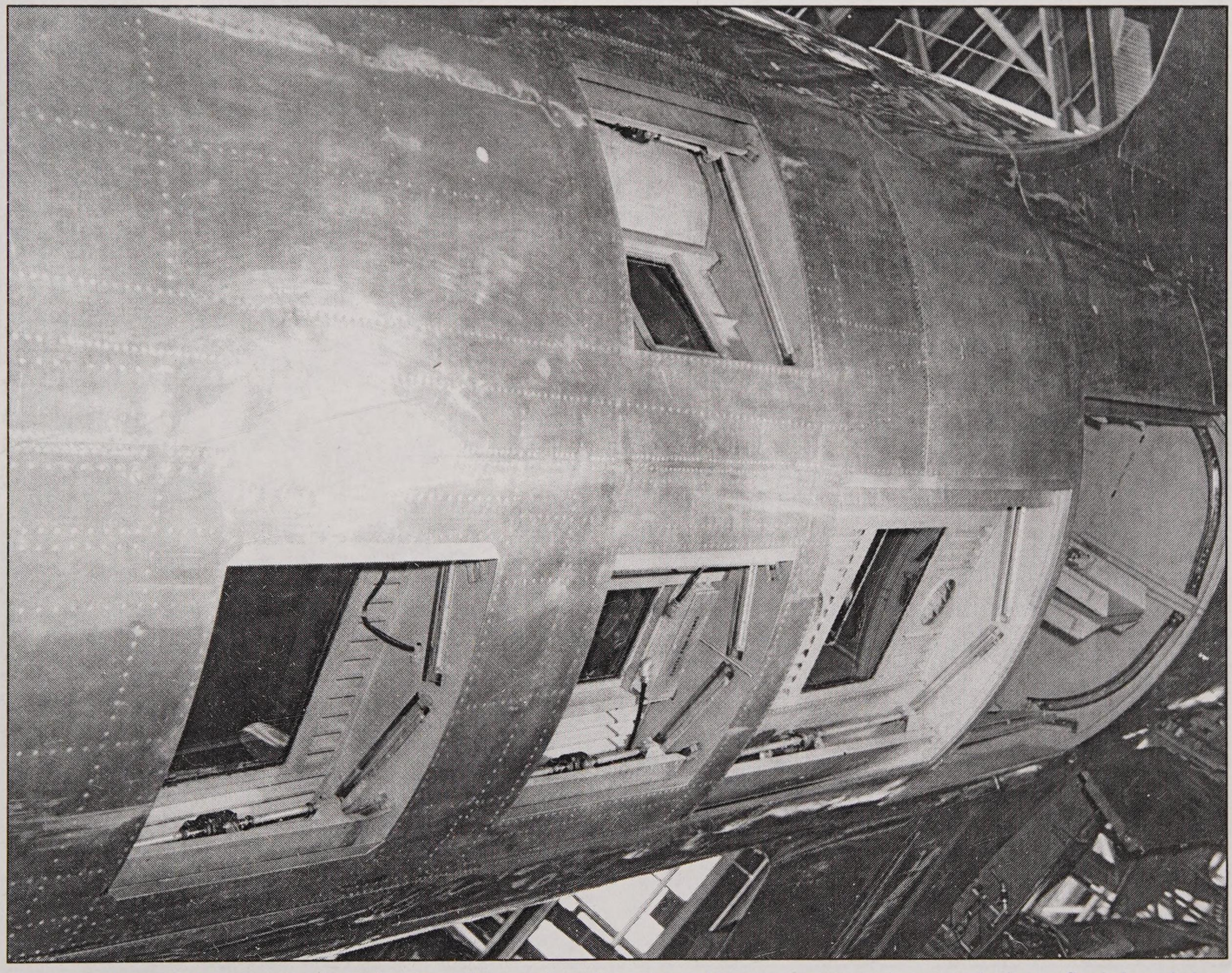
Same view showing the retractable doors in the closed position. Note double row of louvered extractor vents for optimum cooling of the AN/M-46 photo flash bomb bay. (Cradle of Aviation Museum via Dennis R. Jenkins)



Left-hand view of the XF-12's aft fuselage showing all camera bay and bomb bay doors in their closed positions. All of these tight-fitting doors could be operated in flight at any airspeed and without limitation. (Cradle of Aviation Museum via Dennis R. Jenkins)



Left-hand view of the XF-12's rear fuselage showing all camera bay and bomb bay doors in the full open position. This also shows that all camera gear onboard the aircraft was located aft of the wing. (Cradle of Aviation Museum via Dennis R. Jenkins)



Bottom view of the rear fuselage looking forward, and up into the open camera bays and photo flash bomb bay (larger opening at right). From left are windows for the split vertical, trimetrogon, and single vertical cameras. All glass for the camera windows was heated with hot bleed air from the XF-12's engines in flight to avoid icing at high altitudes. (Cradle of Aviation Museum via Dennis R. Jenkins)

- Split vertical combination of 2 Fairchild K-17 cameras with 12-inch and 24-inch lenses
- Split vertical combination of 2 Fairchild K-22 cameras with 24-inch and 40-inch lenses

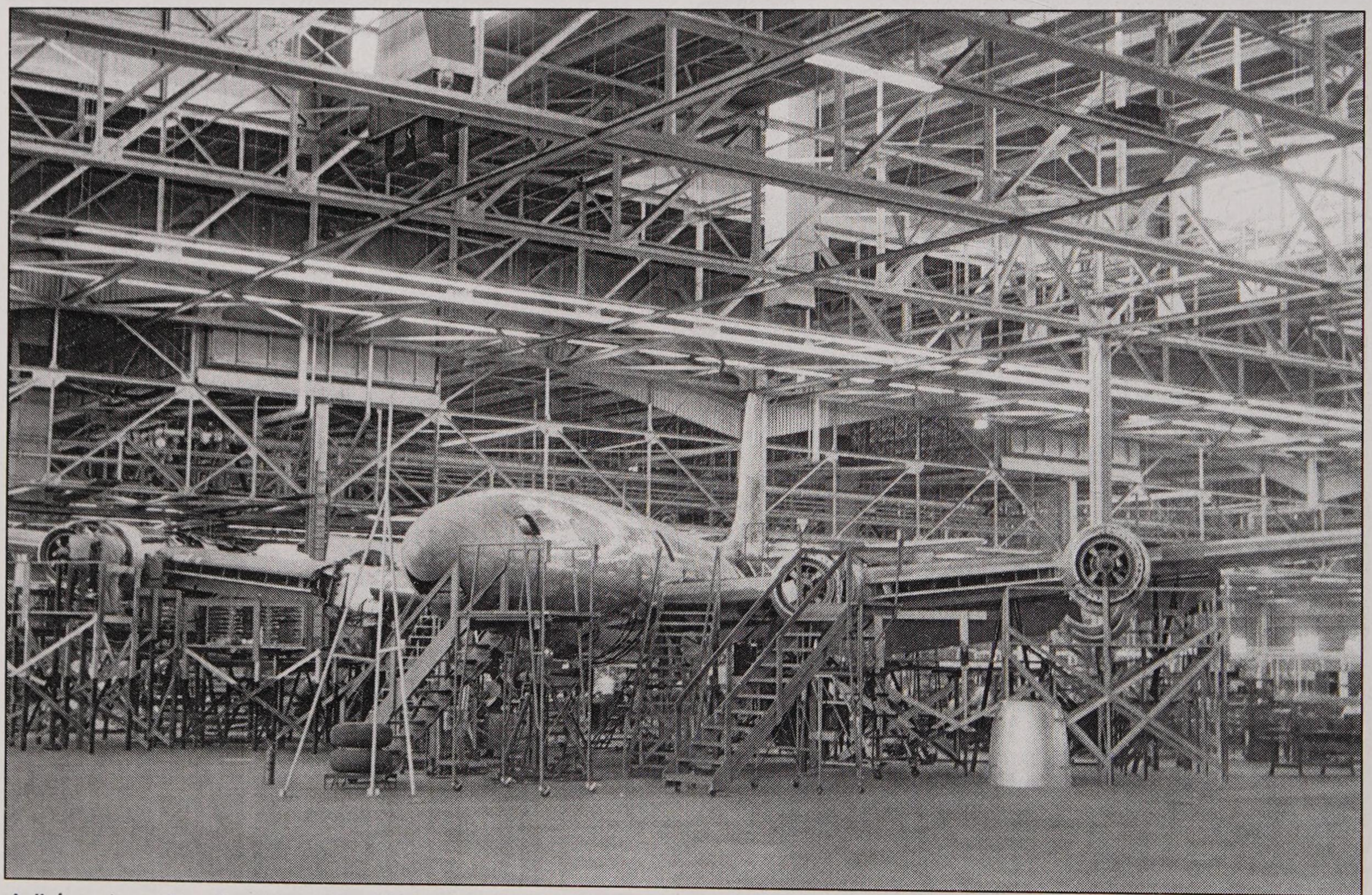
The XF-12's camera windows were heated by force-directed hot air for anti-icing, and were protected when not in use by flush-fitting electrically operated retractable doors that opened or closed laterally. The XF-12's single internal bomb bay was equipped with 18 AN/M-46 long-duration photo flash bombs (flares) for nighttime reconnaissance operations. The photo flash bomb bay was surrounded by heavy integral flak-protection armor, and all flush retractable doors could be operated safely at any airspeed and under any flight conditions.

Crew Complement

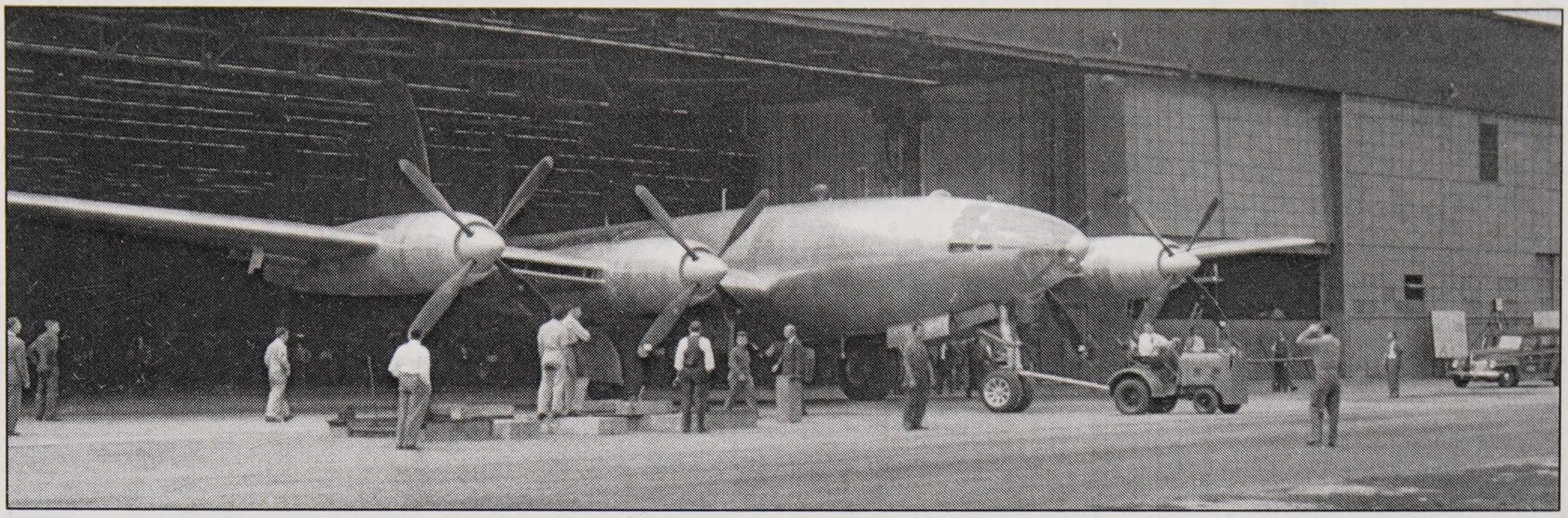
In its operational military role, the XF-12 was to have a full crew complement of seven men. The flight crew was composed of an aircraft commander (pilot and commissioned officer), an aircraft pilot (co-pilot and commissioned officer), and a flight engineer (NCO, or non-commissioned officer). On certain missions, the aircraft's maintenance crew chief also accompanied the flight crew. The main cabin was staffed by an NCO navigator and photographer, plus an enlisted radio operator assisted by one or two enlisted photographic technicians. Early Republic proposals showed cabin stations for as many as 15 crewmembers on long-range intelligence-gathering flights, including five Ferret Radar operators and two weathermen. A smaller crew complement, composed of the three-man flight crew and a single navigator/photographer, was also specified for short-duration missions.

Armament

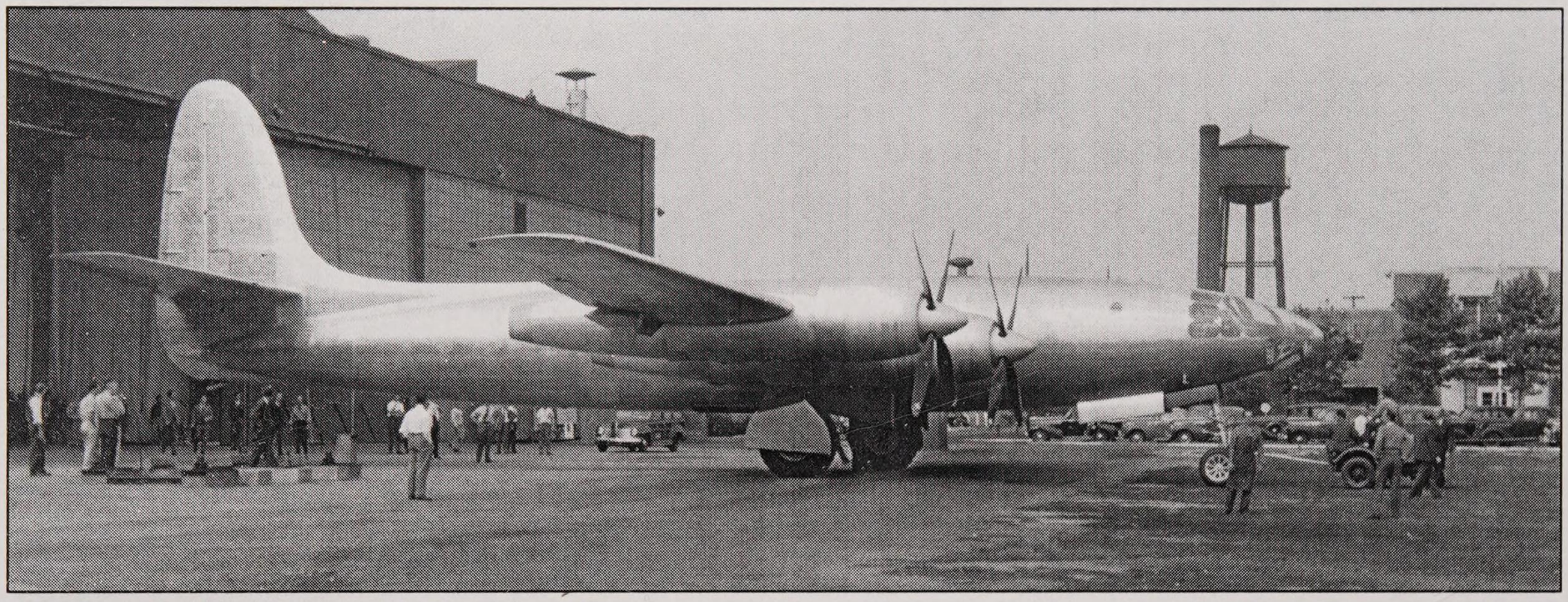
No offensive or defensive armament, or ordnance-carrying capability, was stipulated in the design of the XF-12. Much like similarly unarmed Lockheed U-2 and SR-71 photo-recon airplanes designed in the 1950s and 1960s, respectively, the XF-12's strong suit for defense against enemy attack was its great speed and altitude capability. (Both Lockheed airplanes are explained in more detail in the Epilogue.) As mentioned previously, these attributes quickly waned with the advent of jet-powered interceptors under development during this same time period, not to mention anti-aircraft missiles undergoing initial development in unfriendly countries as well.



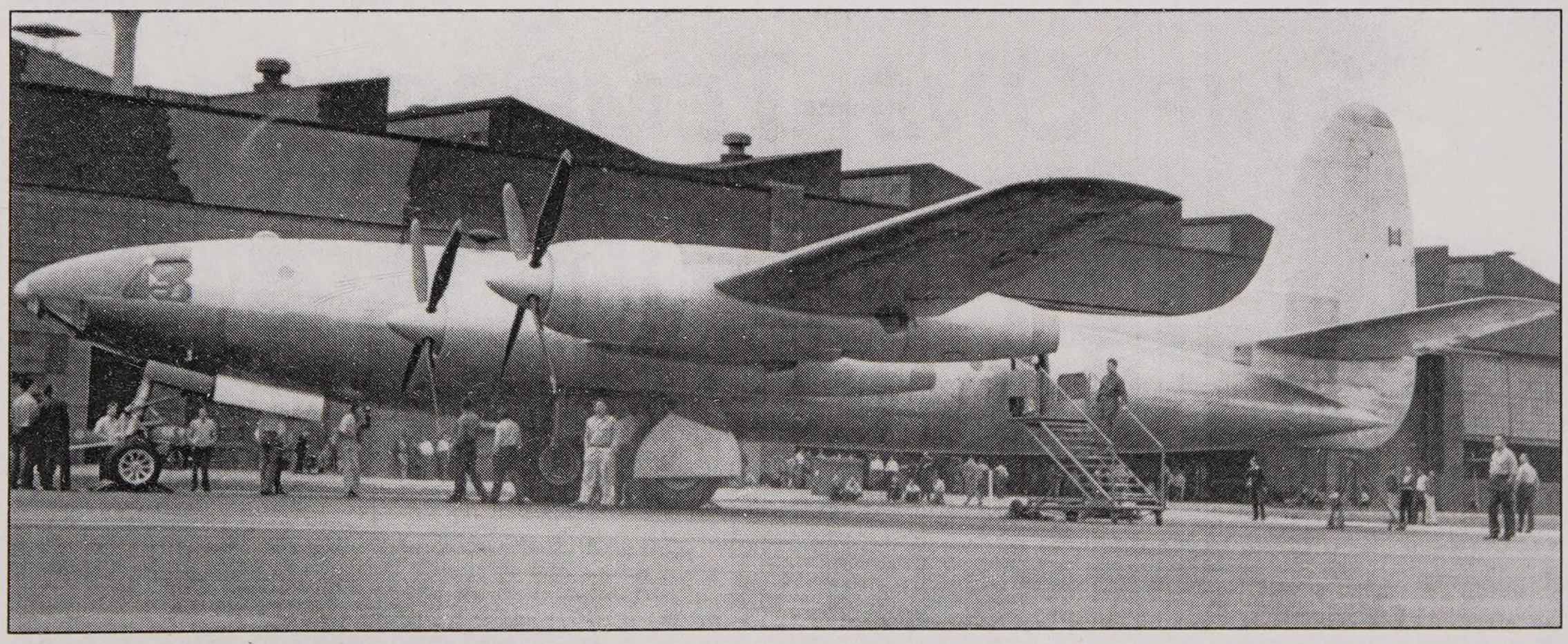
A "sleeping giant" undergoes final assembly in the corner of Building 17, as the first XF-12 takes shape with the mounting of engines and installation of interior furnishings and components. Large fabric sheath covering the clear Plexiglas nose section was mandated by government contract in order to avoid damage to those easily scratched surfaces during the rigors of manufacturing. (Cradle of Aviation Museum via Dennis R. Jenkins)



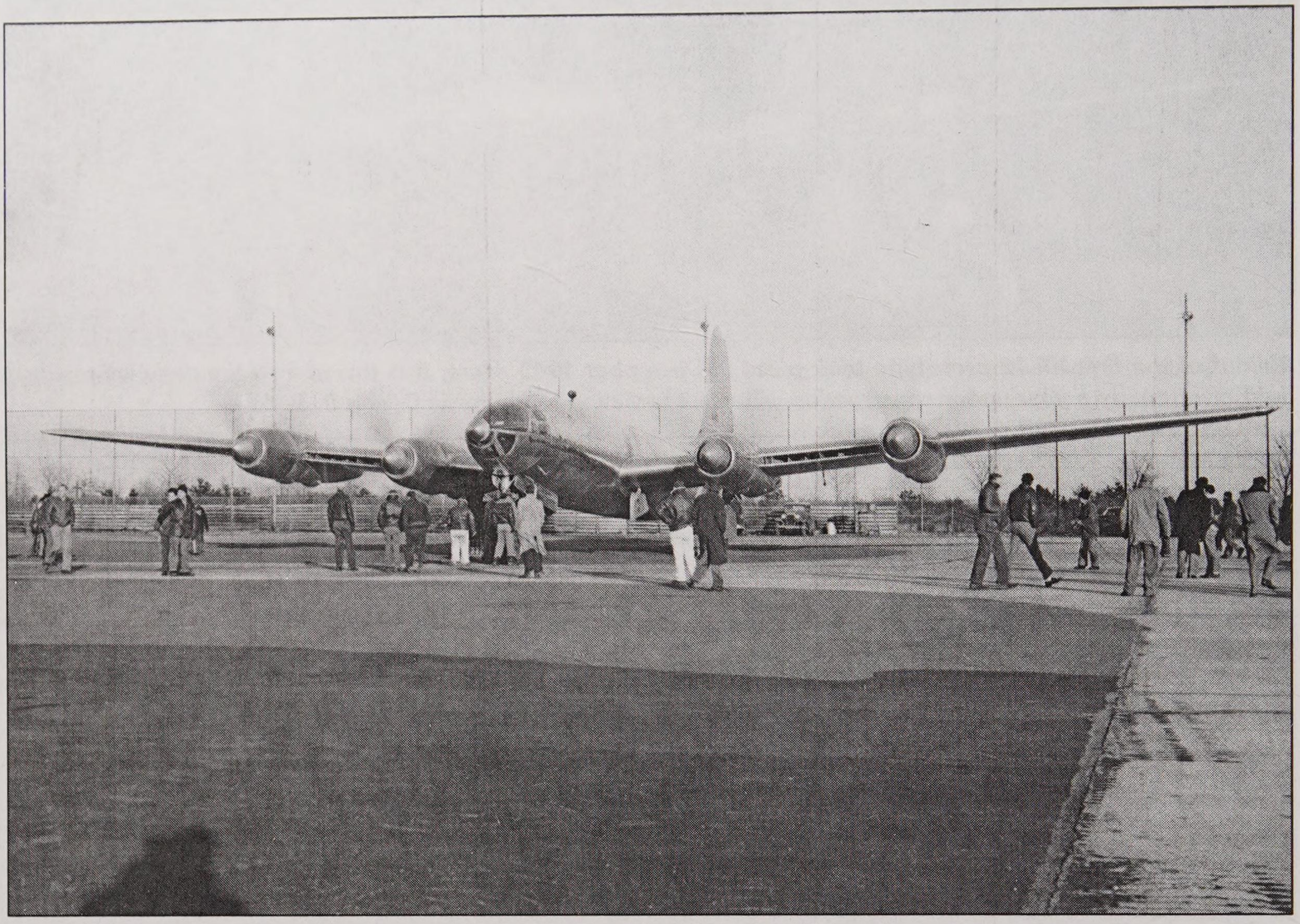
Rollout of the first XF-12 prototype took place in December 1945. Here, it is towed into the early winter daylight after nearly a year under construction. (Cradle of Aviation Museum via Dennis R. Jenkins)



Ship One is shown here with the ground tug and tow bar still attached after the XF-12 had been towed from the Final Assembly Building. Trademark Republic water tower and smokestack in background were constructed in the late 1920s when the manufacturing buildings to the north of this complex were owned by Fairchild. (Cradle of Aviation Museum via Dennis R. Jenkins)



Facing south, XF-12 Ship One is open for inspection. Note large main landing gear doors similar to the P-47, or even the P-35 for that matter. Center cockpit clear-view window has been opened for ventilation of the parked aircraft. (Cradle of Aviation Museum via Dennis R. Jenkins)



"Republic Zero-Zero-Two is ready to taxi . . ." With its four Pratt & Whitney Wasp Majors warmed up and ready for action, XF-12 Ship One prepares to leave the east ramp to begin its maiden voyage on the cold crisp morning of 4 February 1946. The Ford Model A parked at the blast fence makes a compelling contrast as to the technological eras of these two machines. (G. Hildebrand via Author Collection)

SHIP ONE–TEMPORARY TRIUMPH

With the first prototype, called Ship One, finally taking to the air on a routine basis, Phase I flight testing indicated that the XF-12's original design goals were being either met or exceeded. At the same time, however, a sobering realization was creeping into the awareness of Republic's top management, not to mention Air Force planners at Wright Field. Despite having such impressive performance for a large multi-engine piston-powered airplane, the XF-12 was rapidly becoming obsolete even before reaching production or operational service.

High Hopes at Republic — Concern at the Pentagon

With the coming of the jet age was the promise of new, faster, turbine-powered fighters. As impressive as the XF-12's speed and altitude capabilities may have been in the mid 1940s, especially compared to other contemporary propeller-driven aircraft of that era, Republic's new steed was now perceived as being vulnerable to attack by an entirely new breed of enemy jet fighters.

Like the United States, Great Britain, and France, the Soviet Union was also well along in the development of highly maneuverable jet-powered fighters and point-defense interceptors capable of reaching transonic speeds. Any airplane entering America's Cold War aerial arsenal would need to match that performance capability.

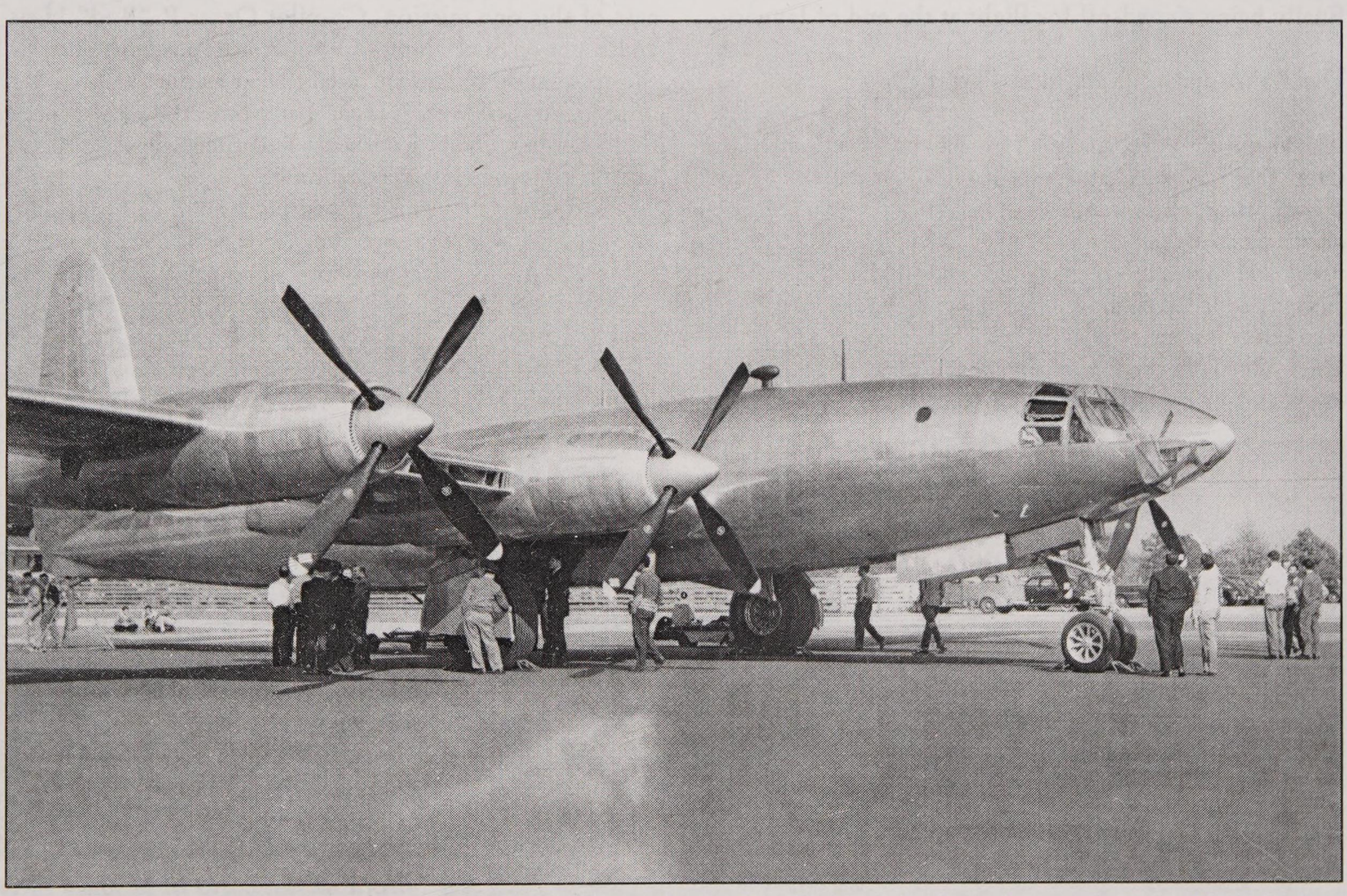
Even as early as March 1944 (the month Republic was awarded the AAF contract to build two prototype XF-12s), military powers in Washington were engaged in controversy over the advisability of continuing with development of the aircraft. One line of logic was that without any offensive armament, and with a perceived lack of maneuverability for such a large airplane, the XF-12 would be highly vulnerable to aerial attack. In an ideological collision between the photo-reconnaissance community and the strategic aircraft mindset, vigorous arguments ensued at the staff level between various factions of the AAF in the Pentagon. These sometimes-heated dialogs dealt with the alleged disparity in requirements for a large photographic aircraft versus a military airplane possessing offensive and defensive maneuverability. By July 1944, these differences had been resolved, however, and the XF-12 was deemed to be fully capable of meeting the Corps of Engineers' requirements.

Construction of the first prototype began in December 1944, and by then, the tide of World War II was clearly turning in favor of the Allies. As the big airplane started to take shape in Farmingdale, there was also a growing sense of optimism and hope throughout Republic that the company had finally harnessed the potential to not only manufacture larger military aircraft, but perhaps even commercial airliners derived from its design. As a result, Republic would finally break free from being relegated to building only single-engine military fighters. Additionally, if the Rainbow airliner was successful, a long-term multi-hundred-aircraft production cycle would be well within reach.

Whether Republic's relatively small manufacturing facilities could cope with the demands of such a large aircraft production run was another story, and obviously, expansion of the Farmingdale plant's more than 1.8 million square feet of floor space would be a must. Perhaps a reactivation of the company's former Evansville, Indiana, plant used years earlier for supplemental P-47 production would be an option.

Where Do We Go From Here?

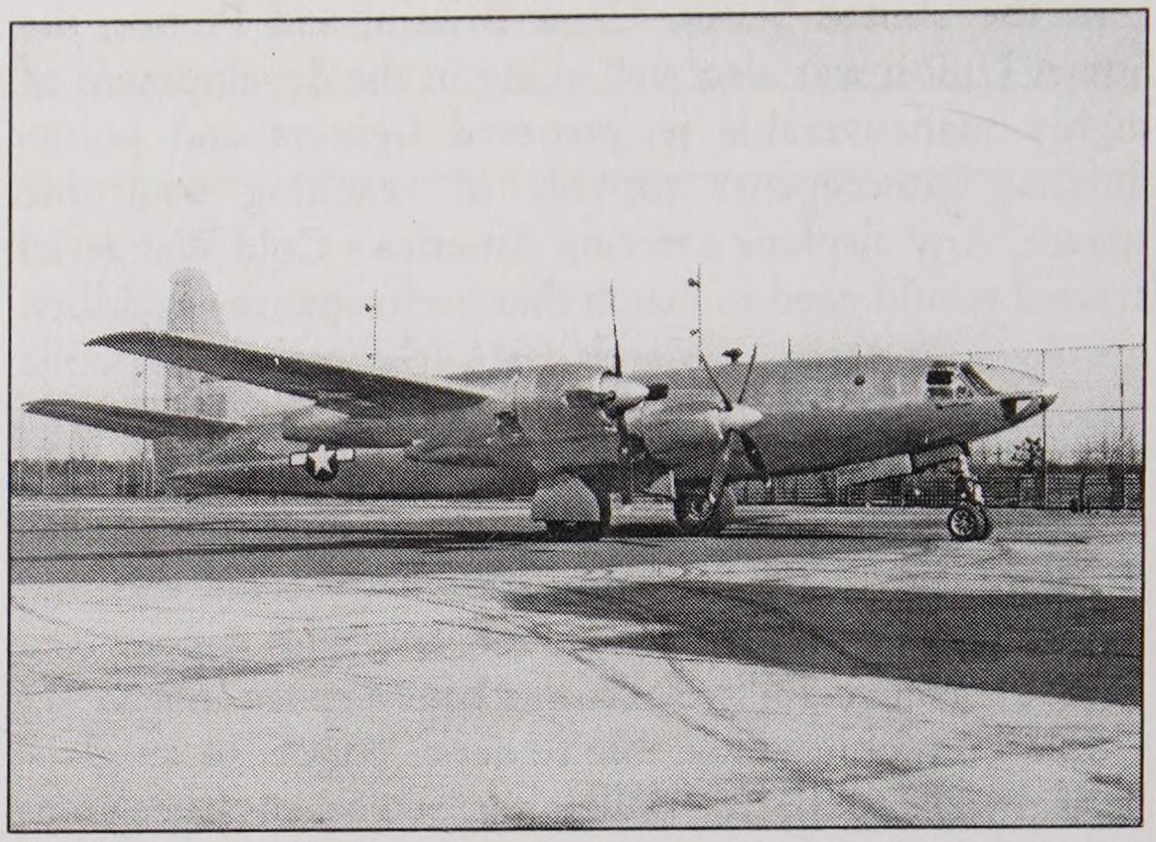
To put the Republic facility's growth into proper perspective, one only had to look to West Coast manufacturers and their own expansion plans. Whereas those companies' airfields had originally been located well away from populated areas when first built in the 1920s, suburban sprawl over the following two decades quickly



The first XF-12, Air Force serial number 44-91002, awaits its first flight parked on the east ramp at Farmingdale in January 1946. (Cradle of Aviation Museum via Dennis R. Jenkins)

grew to surround those sites. Douglas, Northrop, Lockheed, North American, and Convair all opened additional plants to cope with the rapid expansion of their product lines. New test centers near Palmdale, California, and Las Vegas, Nevada, eventually sprang up at the start of the jet age in the early 1950s. On Long Island, even neighboring Grumman moved its flight operations about 60 miles eastward to an area of virgin forest near the town of Riverhead. There, a large airfield with two long runways was constructed in Calverton in anticipation of flight testing all of the company's new jet-powered aircraft for the Navy. At Republic, however, no such plans for growth existed.

Once the first XF-12 was rolled out of the final assembly building in Farmingdale in December 1945, all eyes were on the prize of ensuring that the airplane had a successful, if not flawless, inaugural flight. That first prototype was the largest aircraft ever built on Long Island, and represented a public relations bonanza for the company. Republic's entire plant was abuzz with excitement, not just for the coming Christmas holidays, but for its new airplane as well. By January, the XF-12's systems were being checked, engines were undergoing routine run-ups, and slow-speed taxi tests started being conducted up and down Republic's runways. Initial test data indicated all was progressing normally, and then high-speed taxi runs commenced, with the airplane finally being signed-off for flight at the end of January.

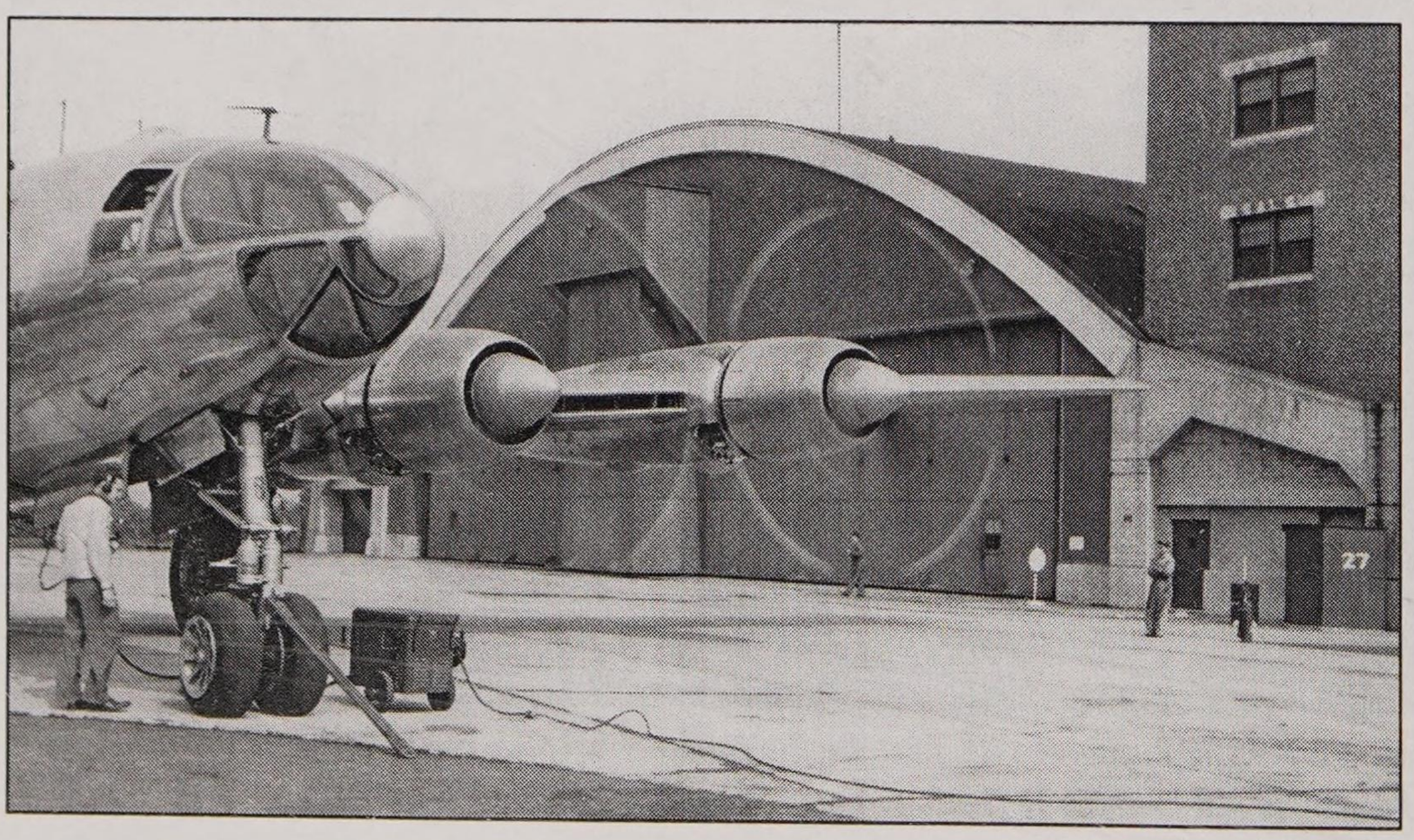


Markings have now been painted on the airplane, consisting of large national insignia on both sides of the rear fuselage plus the upper left and lower right wing. "Republic Rainbow" logotype was also applied on both sides of the nose just below the cockpit windows. Indicating early winter, the long shadow of Republic Field's control tower can be seen at lower right. (Cradle of Aviation Museum via Dennis R. Jenkins)

The Rainbow's "First" First Flight

Monday, 4 February 1946, dawned cold and clear over the flatlands of western Suffolk County, Long Island. Republic's ramp was buzzing with activity as ground service personnel prepared the first XF-12 for its inaugural flight, referred to in the company press as "the first unrecorded flight." (The XF-12 flew again later that week in full view of the media.) That morning, Republic chief pilot Lowery L. Brabham assembled his three-man crew and briefed the details of the flight yet one more time to ensure that everything would work to perfection. In a sense, the company's entire future rested on the success of this one mission. Co-pilot Oscar P. "Bud" Haas and flight engineer James Creamer composed the rest of the crew, and excitement filled the air as they walked out of the ready room in Hangar 3 and onto the ramp where the gleaming silver aircraft awaited them. The 10:00 am takeoff time was fast approaching.

Climbing the short boarding ladder and stepping into the airplane, the three crewmen walked forward to the cockpit and strapped into their seats assisted by Republic ground support personnel. Brabham was no stranger to making first flights, for he was at the controls of the revolutionary XP-47B when it first took off from Farmingdale in May 1941. This day, however, he would pilot an airplane that was five times more powerful than that first Thunderbolt. Soft-spoken, but always in command of the situation, Brabham was the ideal choice for the task, and was well qualified for making the flight.

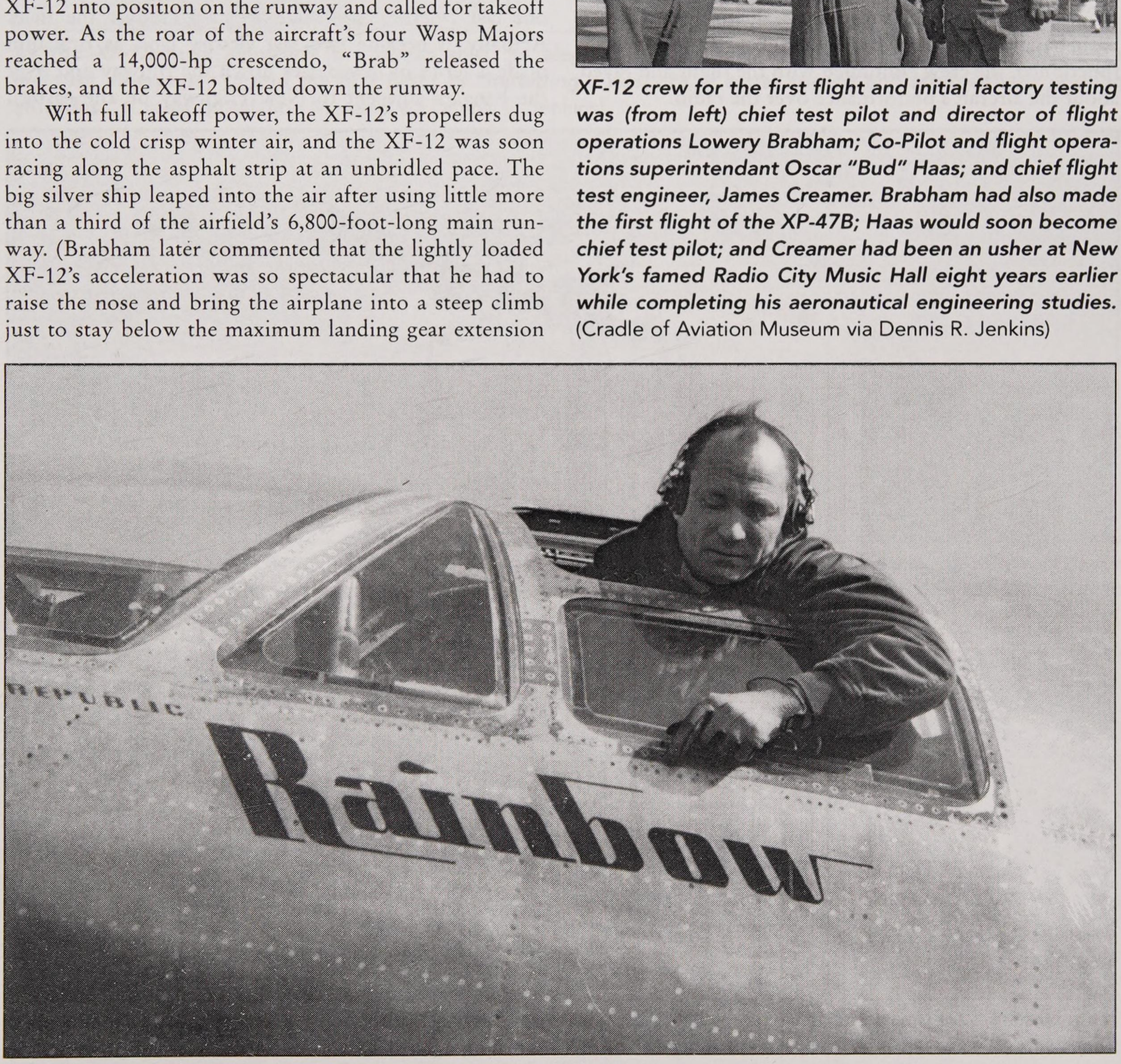


With battery cart at the ready, engines are run up as the XF-12 undergoes final preparation for flight. Although Ship Two is shown here, this would have been similar to the scene in front of Hangar 3 in January 1946. (Cradle of Aviation Museum via Dennis R. Jenkins)

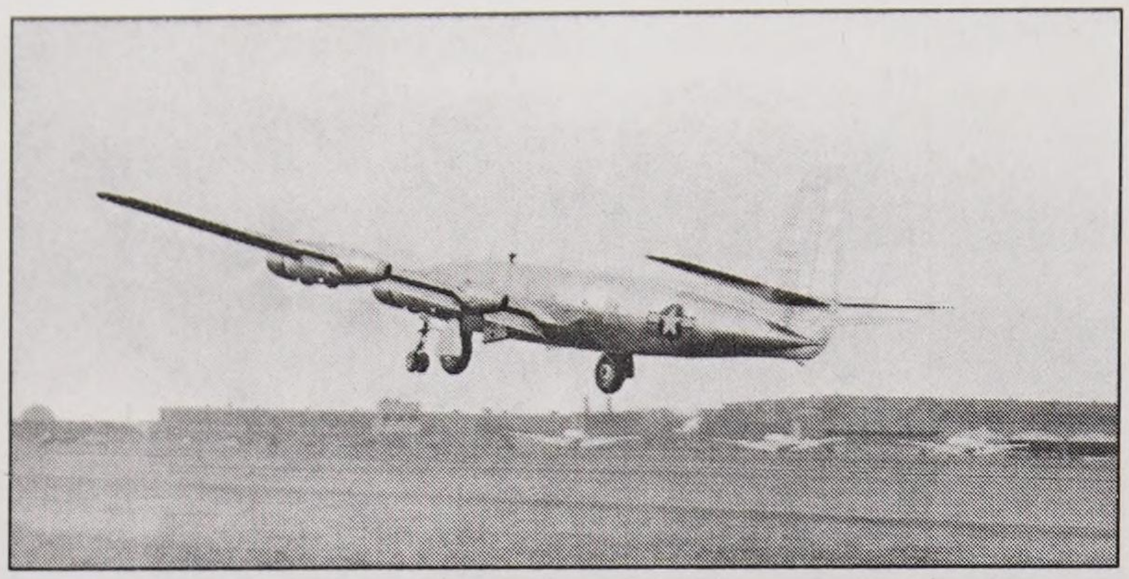
As each of the massive Pratt & Whitney radials coughed to life in a swirl of blue smoke, anticipation built to a fever pitch. Republic's employees, known as "RACers" (for Republic Aviation Corporation), had been given time off from their tasks to witness the big event, and many hundreds of them lined the edges of the ramps adjacent to the runway and on the northern edge of the field. With chocks pulled and engines softly burbling, the sleek prototype pulled away from its parking place and taxied out for takeoff, trundling down to the departure end of Runway three-two. All eyes were on the bright metal ship gleaming in the hazy winter morning sunshine. After making a thorough engine run-up and completing all final checks, Brabham taxied the XF-12 into position on the runway and called for takeoff power. As the roar of the aircraft's four Wasp Majors reached a 14,000-hp crescendo, "Brab" released the brakes, and the XF-12 bolted down the runway.

With full takeoff power, the XF-12's propellers dug into the cold crisp winter air, and the XF-12 was soon racing along the asphalt strip at an unbridled pace. The big silver ship leaped into the air after using little more than a third of the airfield's 6,800-foot-long main runway. (Brabham later commented that the lightly loaded XF-12's acceleration was so spectacular that he had to raise the nose and bring the airplane into a steep climb just to stay below the maximum landing gear extension

XF-12 crew for the first flight and initial factory testing was (from left) chief test pilot and director of flight operations Lowery Brabham; Co-Pilot and flight operations superintendant Oscar "Bud" Haas; and chief flight test engineer, James Creamer. Brabham had also made the first flight of the XP-47B; Haas would soon become chief test pilot; and Creamer had been an usher at New York's famed Radio City Music Hall eight years earlier while completing his aeronautical engineering studies. (Cradle of Aviation Museum via Dennis R. Jenkins)



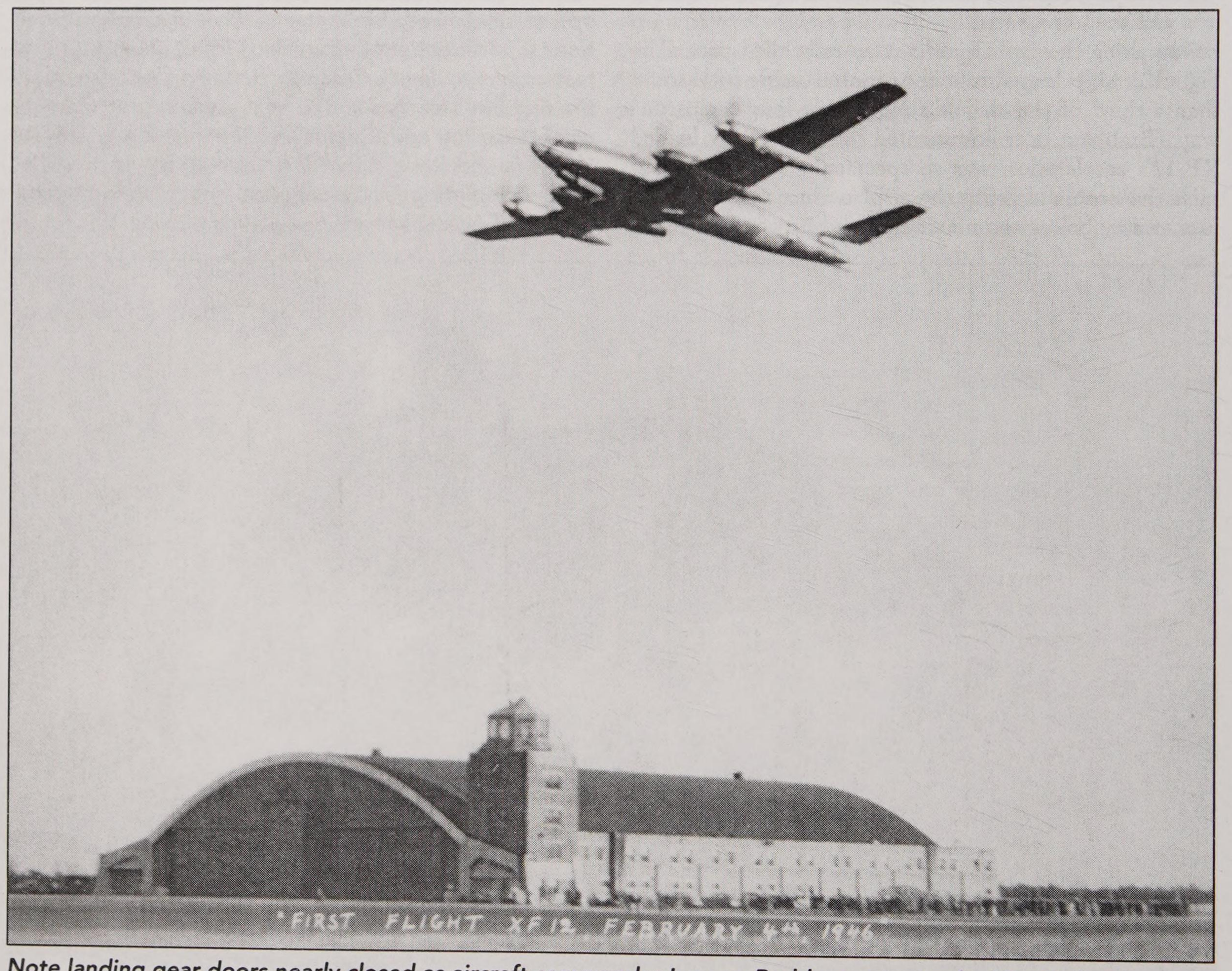
With earphones on, Republic's chief test pilot Lowery Brabham leans out of the center cockpit window and signals to the ground crew before the XF-12's first flight. Note stylish Art Deco "Rainbow" logotype painted below the cockpit in reverse italic typeface. (Cradle of Aviation Museum via Dennis R. Jenkins)



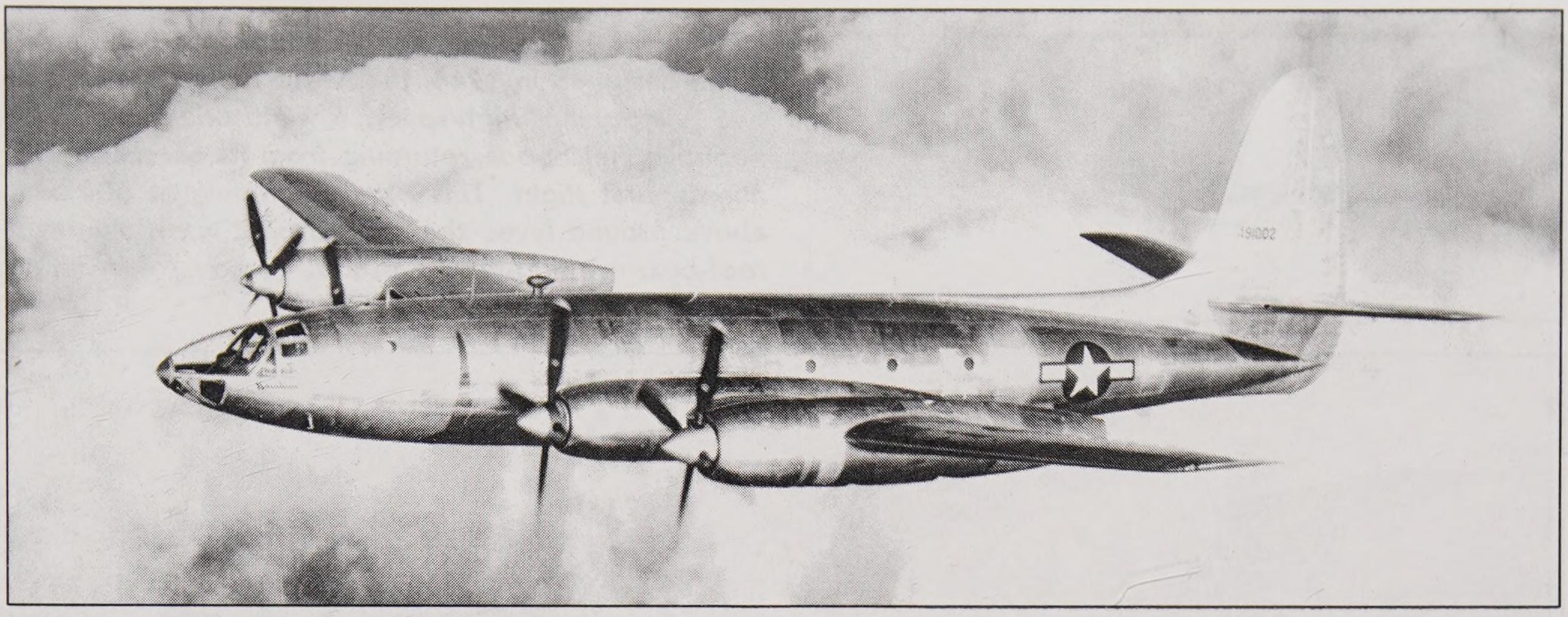
Takeoff! The lightly loaded XF-12 leaps into the air after using less than half of Republic Field's 6,800-foot-long main runway. (Cradle of Aviation Museum via Dennis R. Jenkins)

speed!) Banking to the left, Brabham turned the airplane westward and then south over the beaches of Long Island and the frigid waters of Great South Bay. Leveling off at 10,000 feet, he began gently evaluating the XF-12's basic handling and stability. Although a flap motor malfunctioned, the crew continued with the flight and raved about the aircraft's performance over the radio.

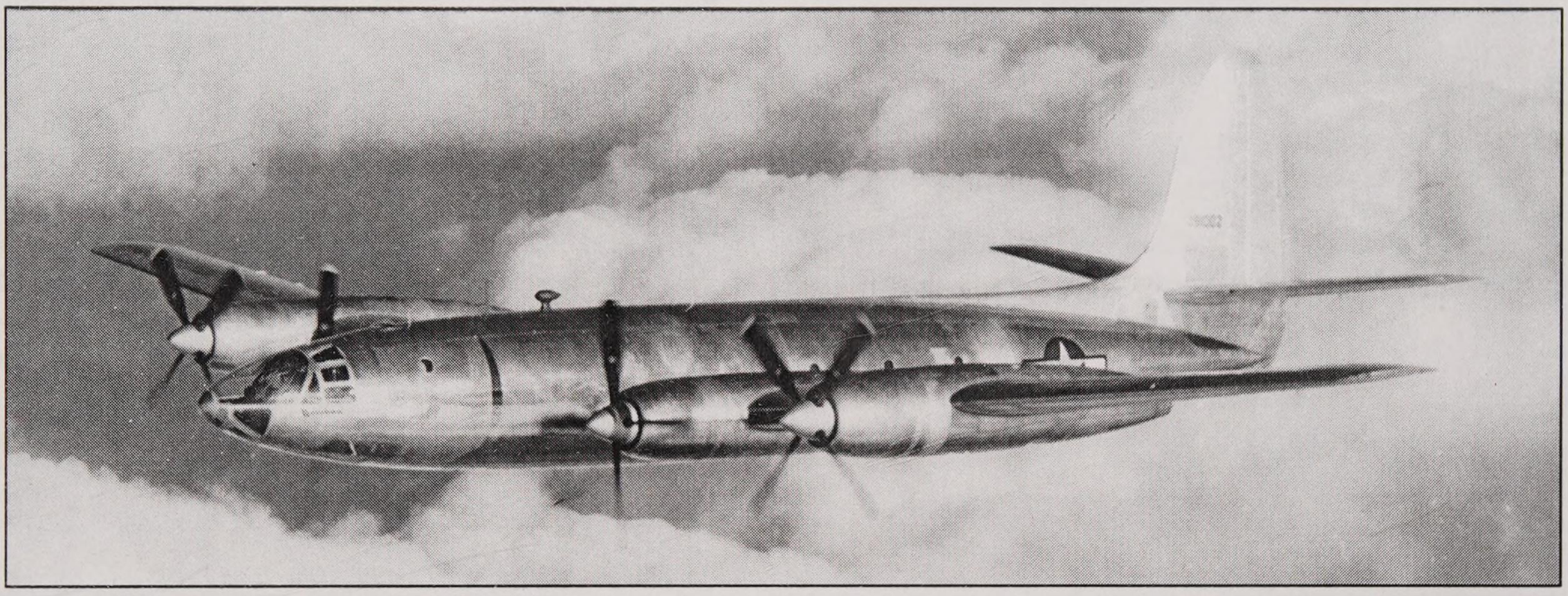
After a successful 45-minute maiden voyage, the XF-12 descended into the landing pattern and re-appeared above the hangars at Republic Airport for one last "victory lap" high-speed pass over the field. Actually, it became two last victory laps, as Brabahm made a series of low passes down the runway and over the hangars adjacent to New Highway on the eastern



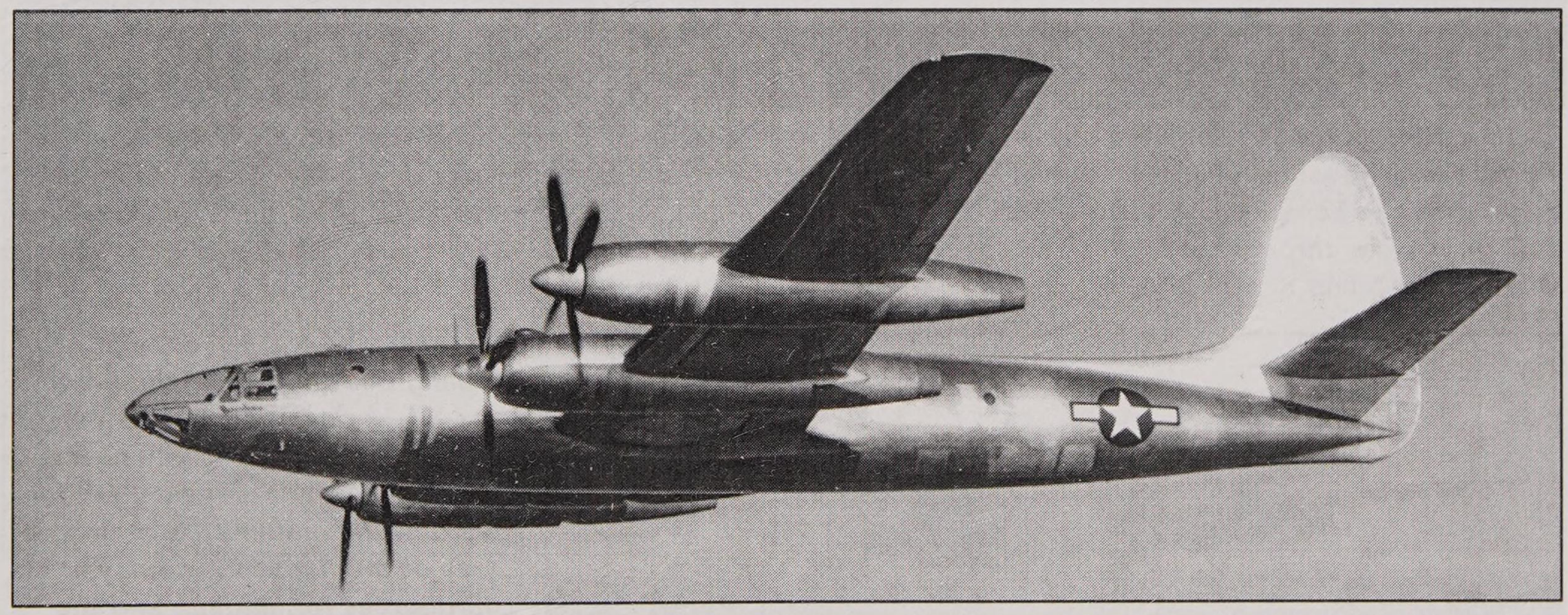
Note landing gear doors nearly closed as aircraft commander Lowery Brabham retracts the XF-12's landing gear in a steep climb in order not to exceed the gear doors' maximum operating speed. By comparison, the normal deck angle on takeoff for a contemporary piston-powered airliner of that era was a mere 3 degrees. Part of the crowd of hundreds of excited Republic employees out to witness the event can be seen next to Hangar 3 in the background. (Cradle of Aviation Museum Archive)



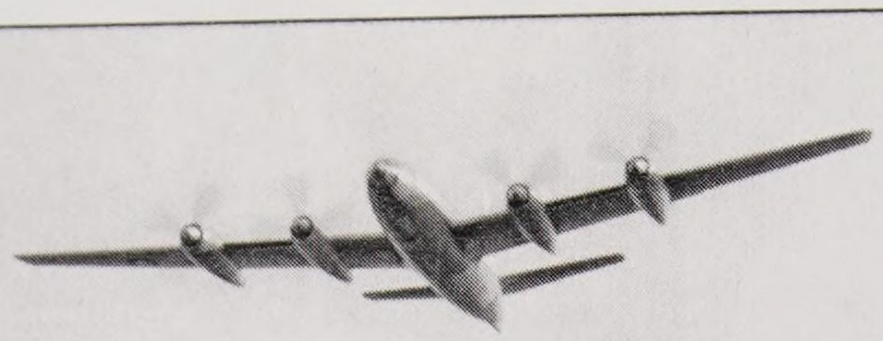
As the XF-12 pulls alongside the photo ship, its elegant and graceful lines become apparent. Republic's in-house newspaper touted the first flight as "heralding a new era of super speeds and stratospheric cruising altitudes." (Cradle of Aviation Museum via Dennis R. Jenkins)



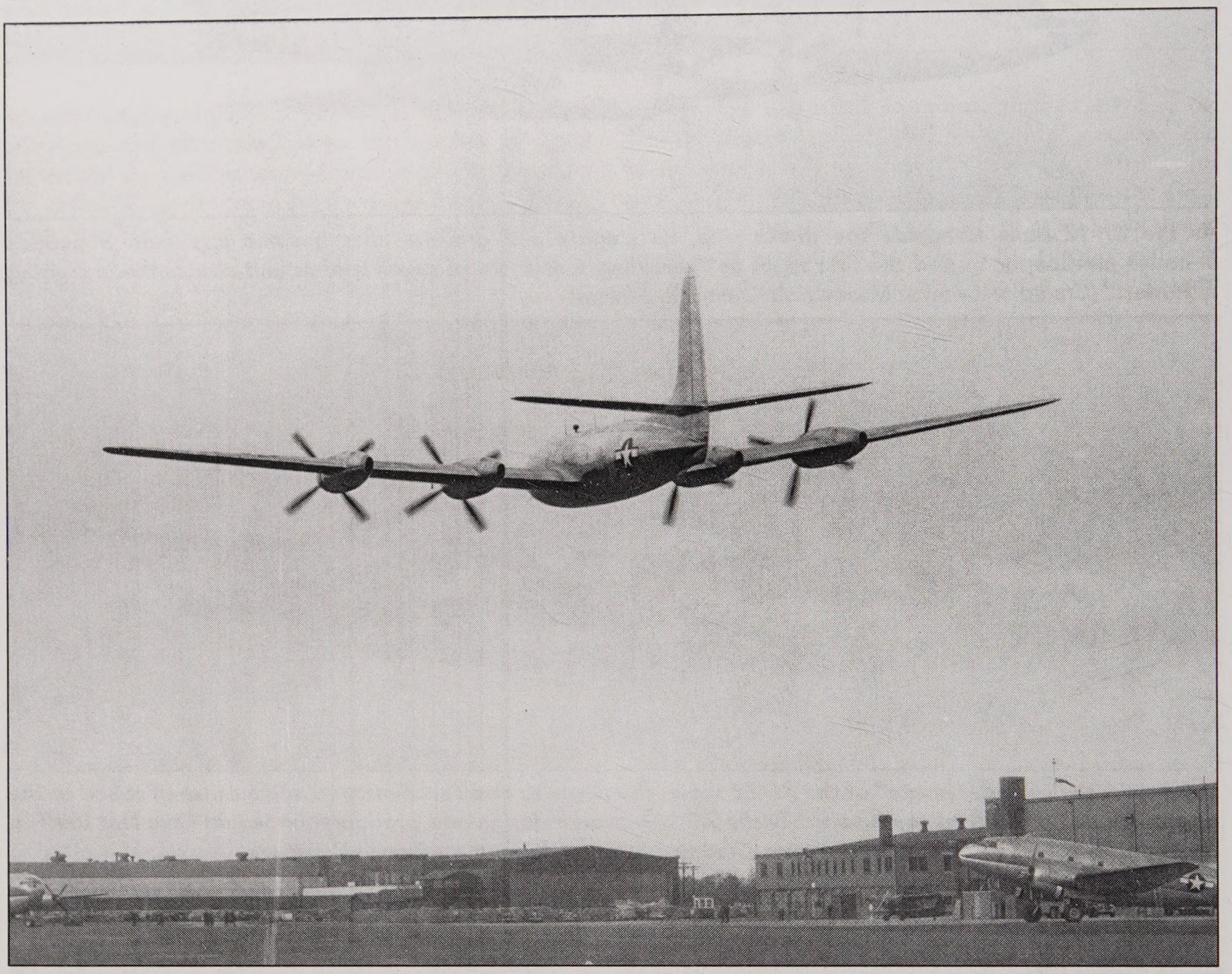
Classic airline "calendar photo" of the XF-12 shows the aircraft's sleek silhouette to add a sense of speed to the photo. It's not difficult to see how easily the XF-12's overall design and configuration would have lent itself to operating successfully in the airliner role. (Cradle of Aviation Museum via Dennis R. Jenkins)



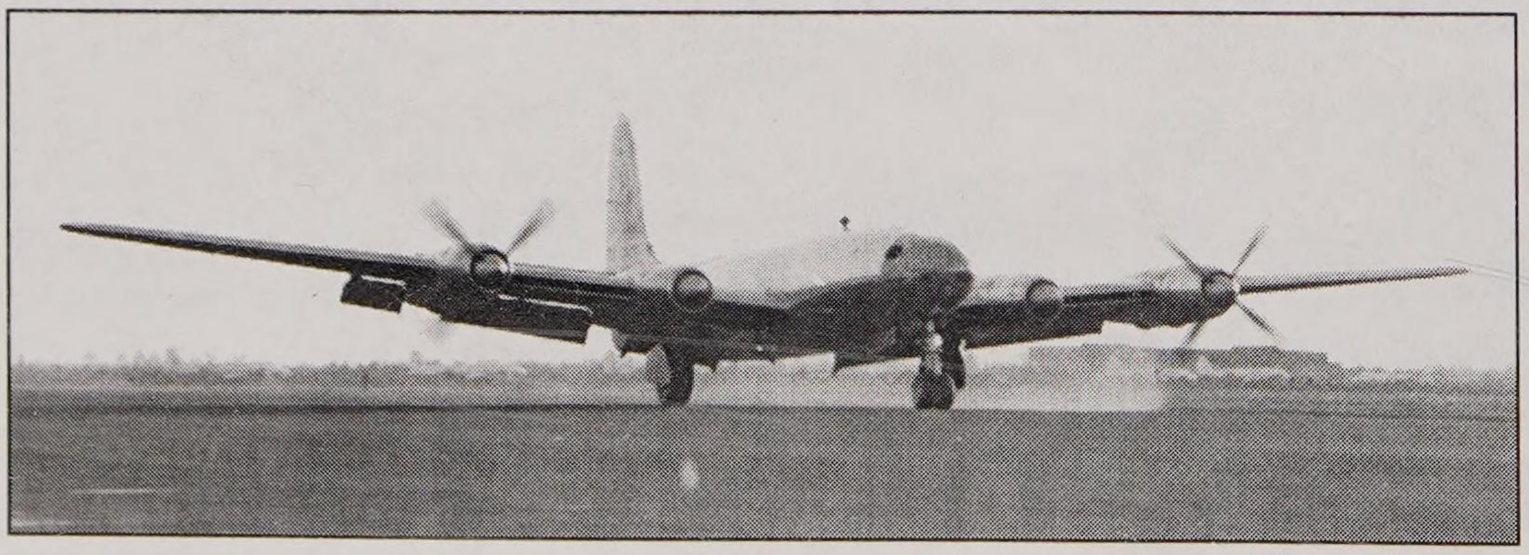
With the obligatory inflight photo series completed, Ship One banks away from the Curtiss C-46 photo chase airplane and begins its return trip to Republic Field. (Cradle of Aviation Museum via Dennis R. Jenkins)



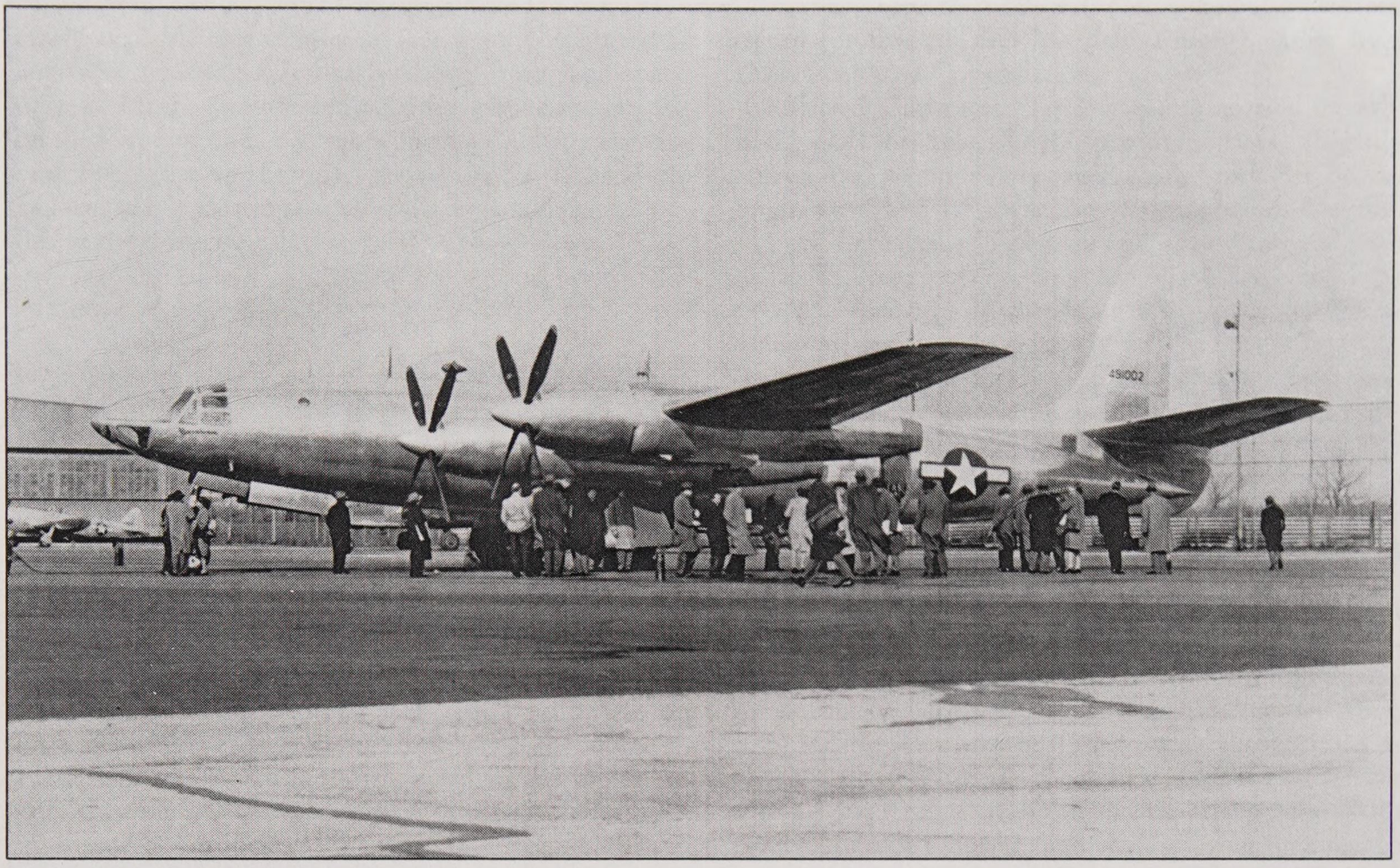
Looking much sleeker than a typical four-engine airplane designed in 1944, the XF-12 makes the first of two "victory lap" high-speed, low-altitude passes over Republic Field upon returning from its successful 45-minute first flight. This pass was flown at 500 feet above ground level; the second pass was flown at a roof-buzzing 200-foot altitude. (Cradle of Aviation Museum)



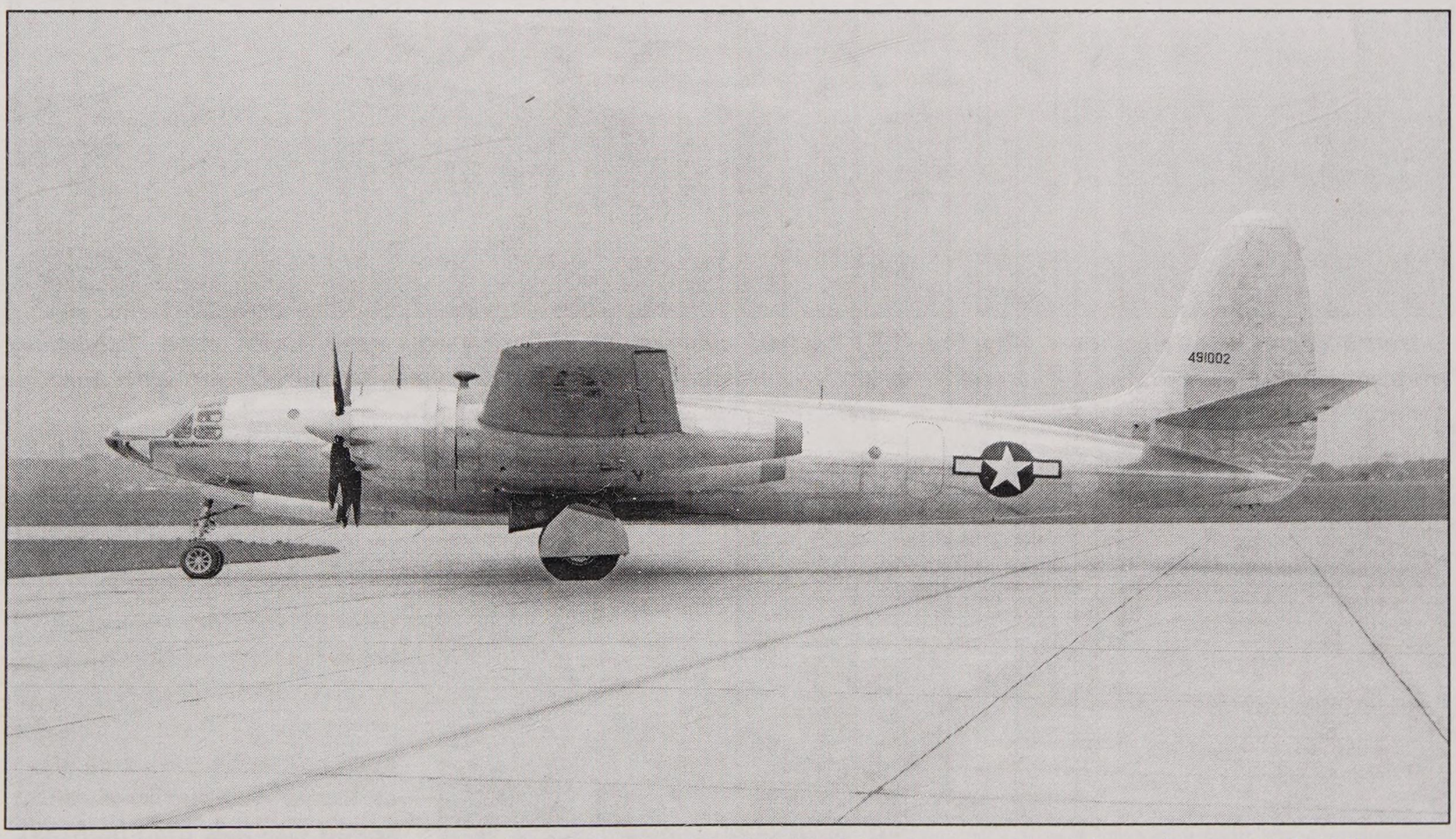
Factory photographers stationed at the side of the runway caught this dramatic view of the XF-12's second low-altitude high-speed pass just as Lowery Brabham begins to pull up before reaching the crowd of Republic employees positioned at the north end of the field. Main plant in background is still adorned in the mottled camouflage it wore throughout World War II to guard it from long-range enemy aerial attack. (Cradle of Aviation Museum via Dennis R. Jenkins)



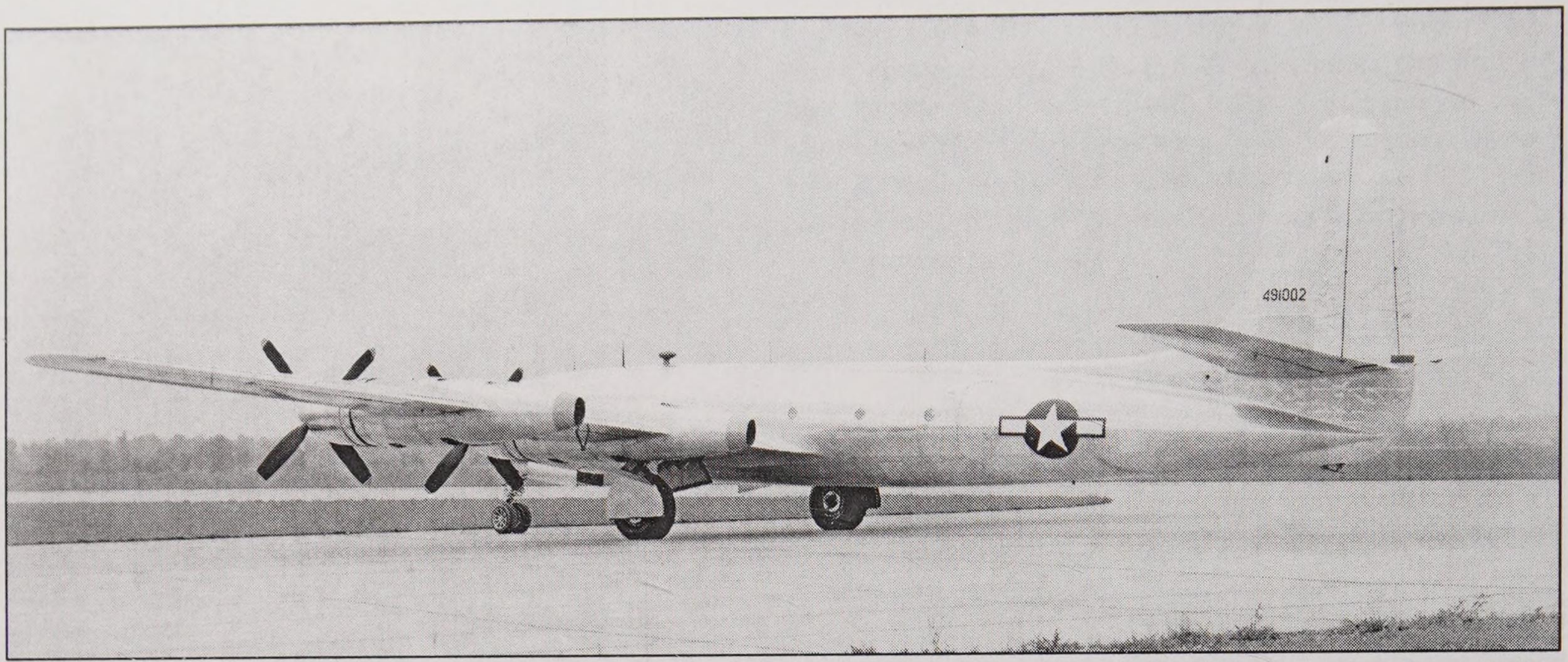
Rolling out on Runway three-two, the XF-12 decelerates with its inboard propellers fully reversed, as indicated by the dust cloud forward of the engines. Note surface area of the flaps fully deployed at 60 degrees for landing, and the slower-turning outboard props. (Cradle of Aviation Museum)



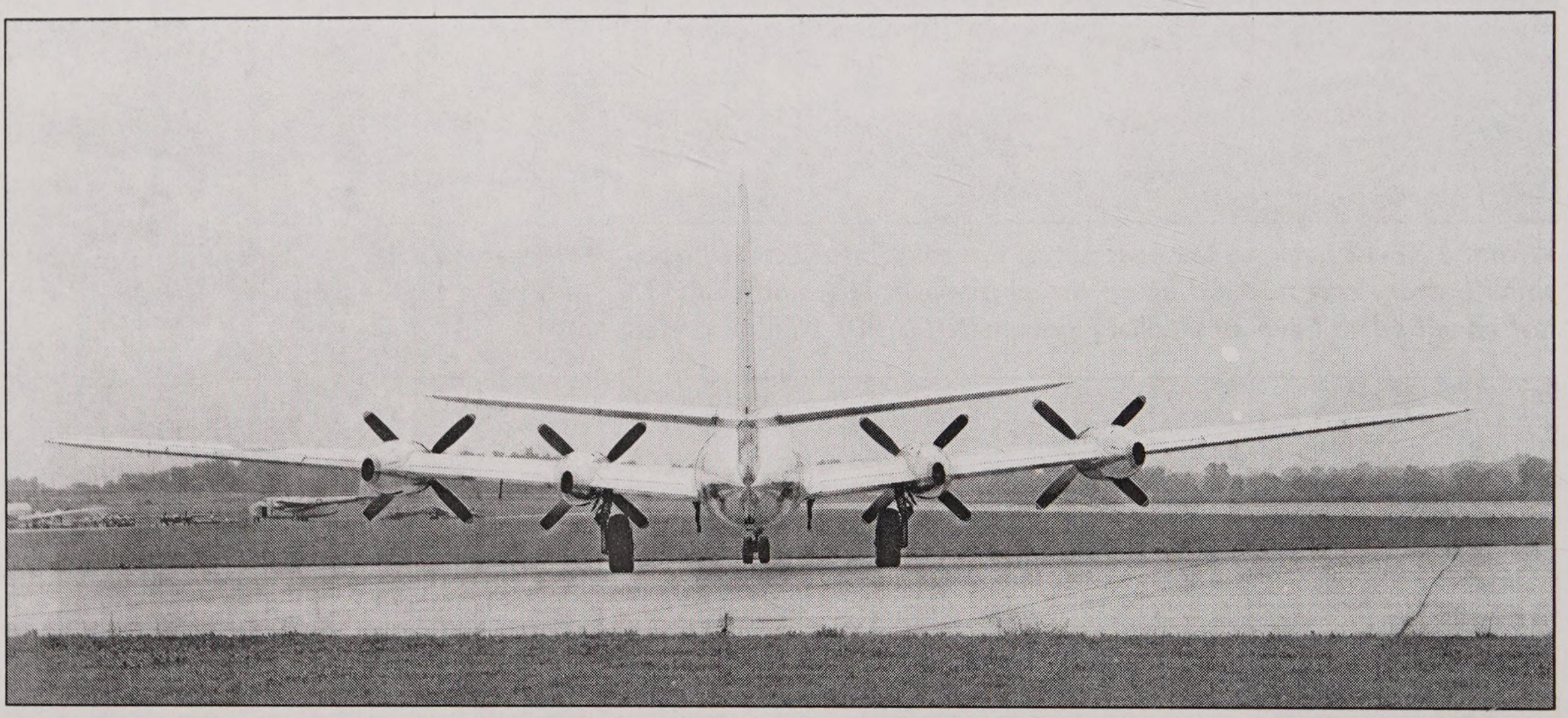
With the XF-12 back on the east ramp, the celebratory crowd begins to dissipate after the inaugural flight. Note small battery cart hooked up to the airplane at left, and the P-47D parked in the background. The XF-12 was not specified to have an auxiliary power unit (APU). (Author Collection)



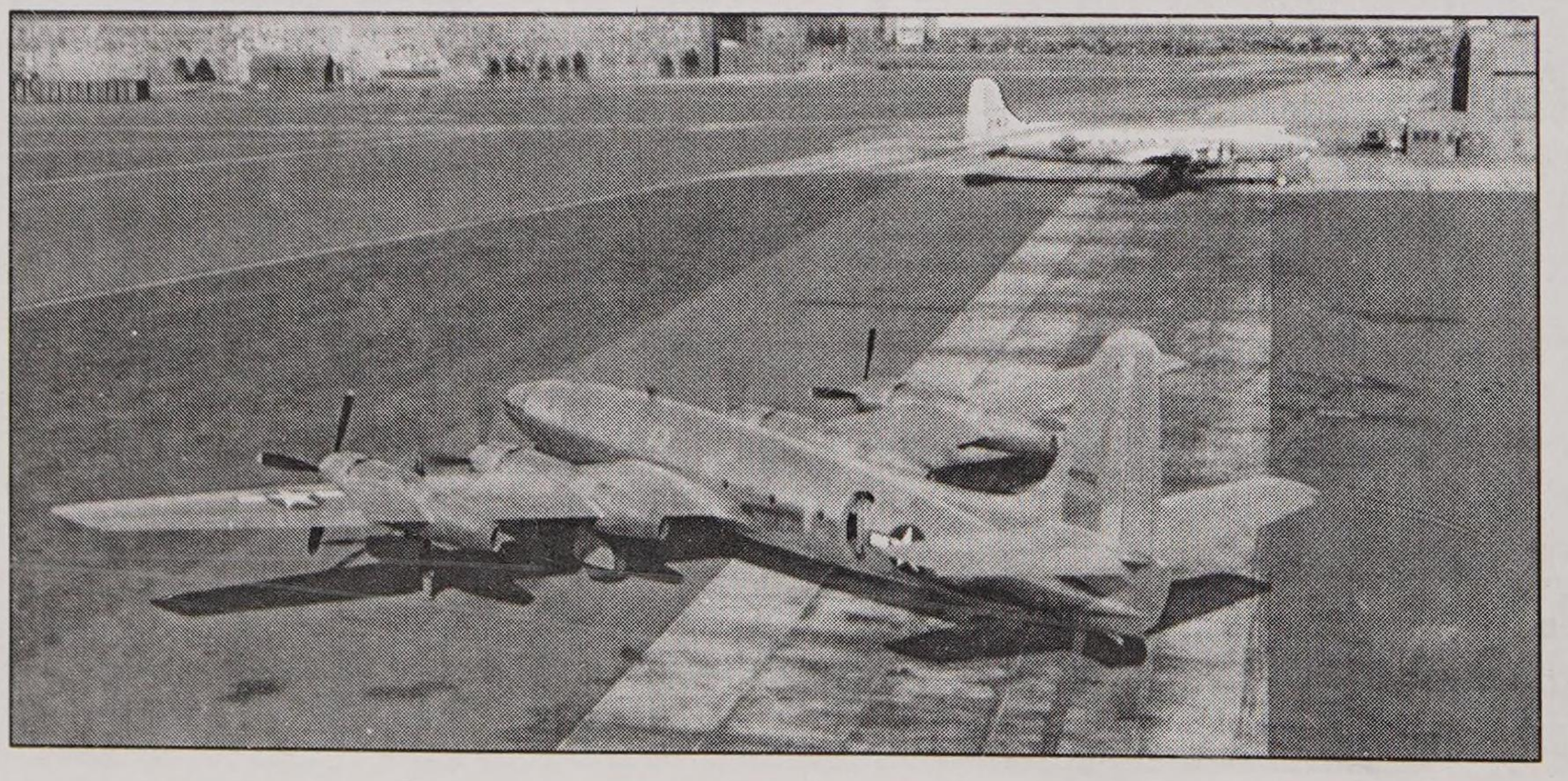
Left-hand profile view reveals the XF-12's rather stubby forward fuselage and teardrop shape. RC-2 airliner version would have incorporated a 5-foot fuselage stretch ahead of the wing to accommodate its 40-passenger payload. (Cradle of Aviation Museum via Dennis R. Jenkins)



This rear-three-quarter view shows the XF-12's aft fuselage and tail group to best advantage. Top of the aircraft's vertical stabilizer was nearly 30 feet off the ground. (Cradle of Aviation Museum via Dennis R. Jenkins)



Extreme rear elevation shows why the XF-12 could achieve its 450-mph top speed with ease. Exhibiting whippet-sleek streamlining, this aircraft epitomized designer Alexander Kartveli's preoccupation with aerodynamic cleanliness. (Cradle of Aviation Museum via Dennis R. Jenkins)



Back at Farmingdale in early 1948, XF-12 Ship One shares the ramp between Hangars 2 and 3 with a military Douglas C-54 Skymaster. A product of an earlier generation of four-engine piston-powered transports, the C-54 was approximately the same size as the XF-12, but its cruising speed was less than half that of the Republic airplane. (Cradle of Aviation Museum via Dennis R. Jenkins)

periphery of the airport. Original newsreel footage currently available on the Internet (see www.youtube.com/watch?v=eeu04VaxssU) clearly shows both high-speed passes with the airplane only 200 feet above the ground on the first one, and at about 500 feet altitude on the second. Footage of the first pass shows the XF-12 head-on, and just barely clearing the tall chimney on Hangar 2 visible in the foreground!

Testing at Republic and Wright Field

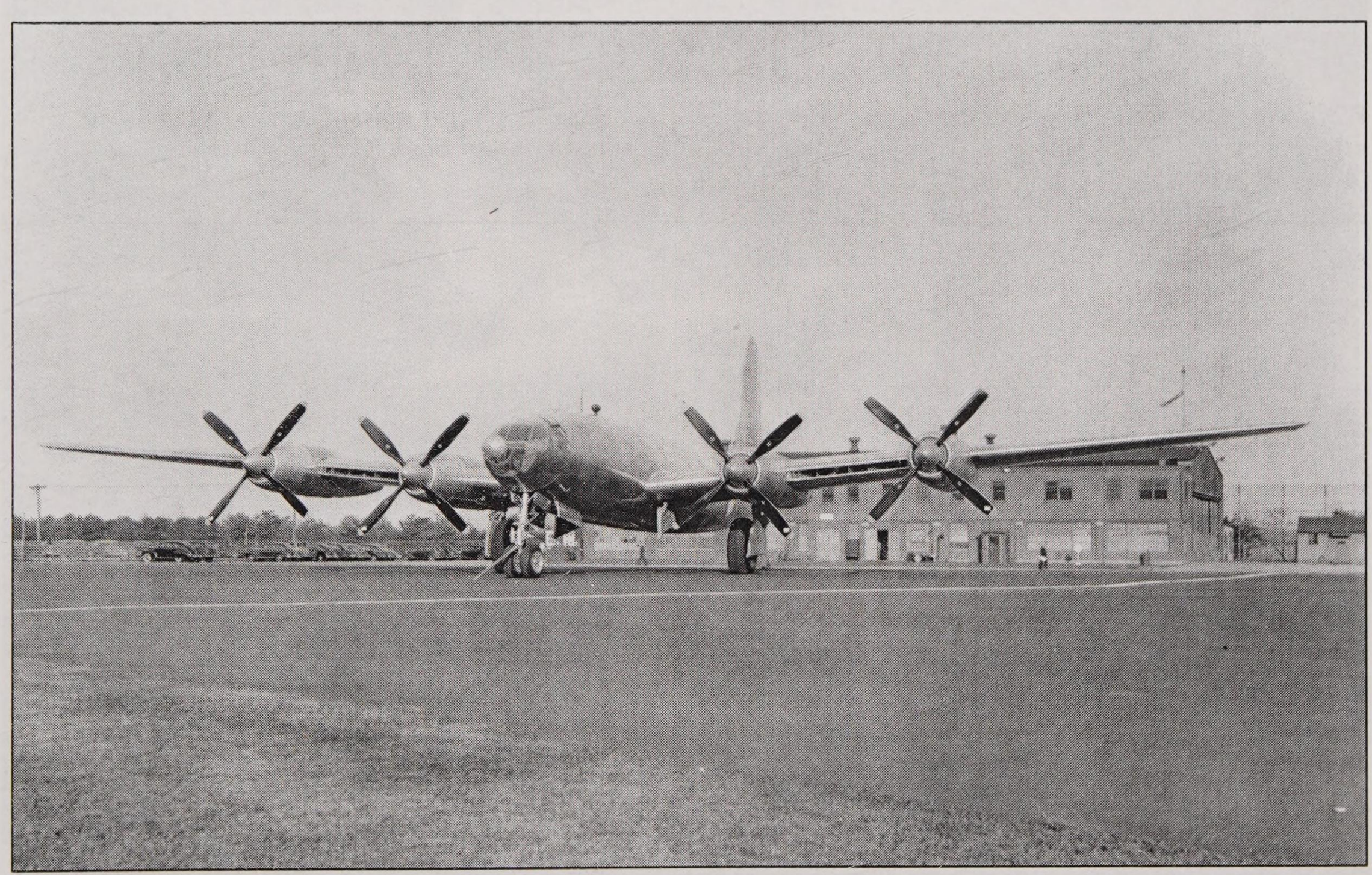
The airplane flew again three days later on Thursday, 7 February, in what Republic called its "first recorded flight" with the press in full attendance. Ship One then began a 45-hour contractor flight test program where Republic crews put the XF-12 through its paces for Phase I of its Army Air Forces' testing. During airspeed calibration tests in straight-and-level flight, the XF-12 left doddering older Douglas C-47 and Curtiss C-46 photo chase airplanes in the dust as it passed by at speeds of more than 450 mph.

During one test flight from Wright Field in Dayton back to Farmingdale (again with Brabham at the controls), the XF-12 set a cross-country speed record of 1 hour and 45 minutes, averaging an astonishing speed for a multi-engine propeller-driven aircraft of 426.6 mph. (This was more than 50 mph faster than the previous record for that trip, set less than a month earlier by a TWA Lockheed Constellation.)

Phase I Contractor Testing was completed in early 1947, and the first XF-12 prototype was officially turned over to the newly designated Army Air Forces Engineering and Test Branch at Wright Field in Dayton. Shortly thereafter, military test pilots commenced with Phase II acceptance testing and expanded the flight envelope to begin adapting the airplane to its operational mission.

On 10 July 1947, with the airplane back at Farmingdale, an interesting incident occurred that inadvertently demonstrated the consummate structural attributes of the XF-12. Although the event became an unsolicited testimonial to the aircraft's ultra-rugged construction, it put more than a slight crimp in the testing schedule for Ship One.

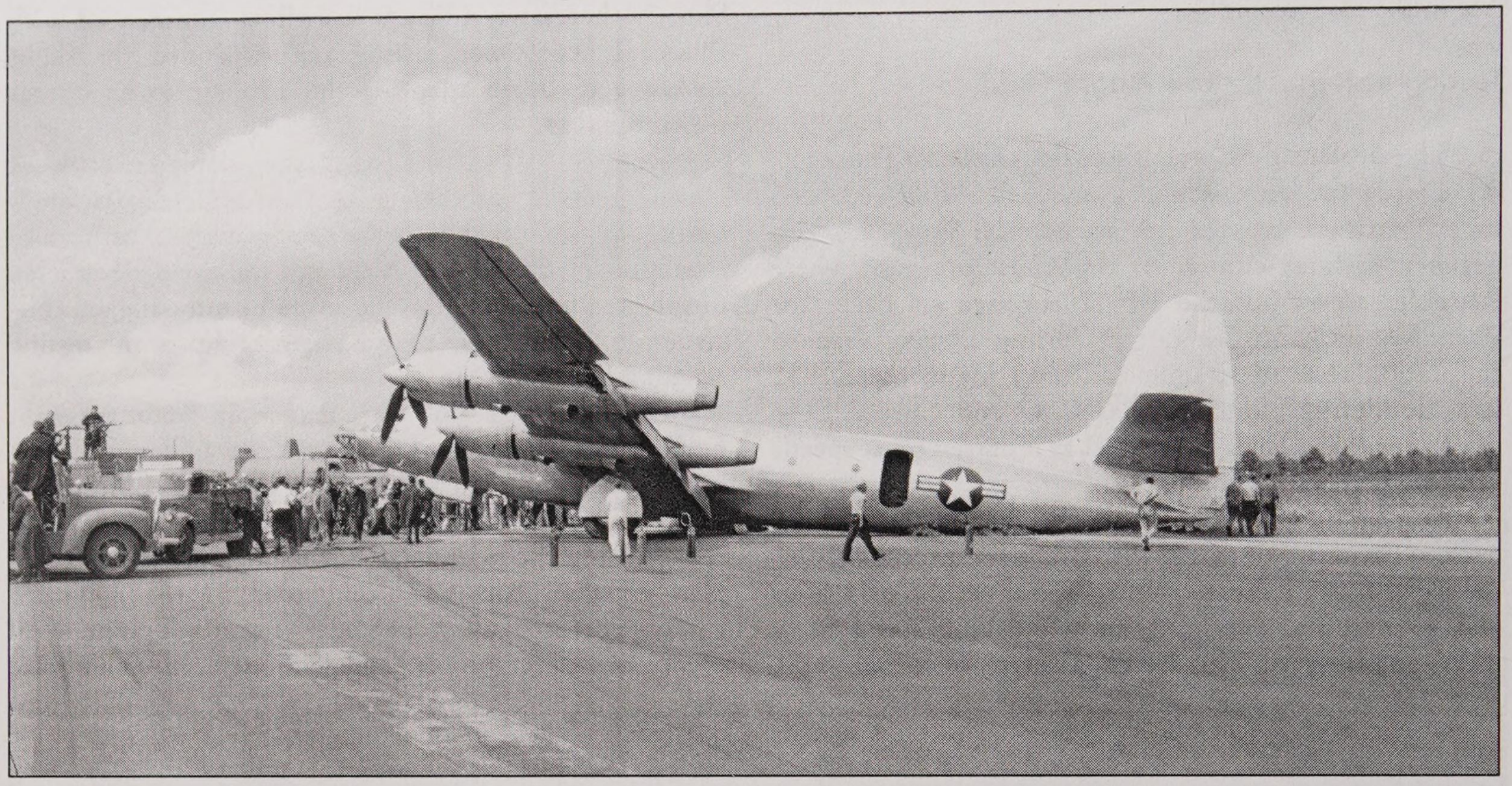
During a high-sink-rate, maximum-landing-weight qualification flight, an Air Force crew under the command of Wright Field project pilot Capt. Bill Elliot made an extremely hard touchdown on Runway one-four, compressing the mainwheel oleo shock absorbers completely to their stops, and cleanly snapping the right main landing gear strut off at the underwing attach point. With plenty of reserve power (and without even nicking the



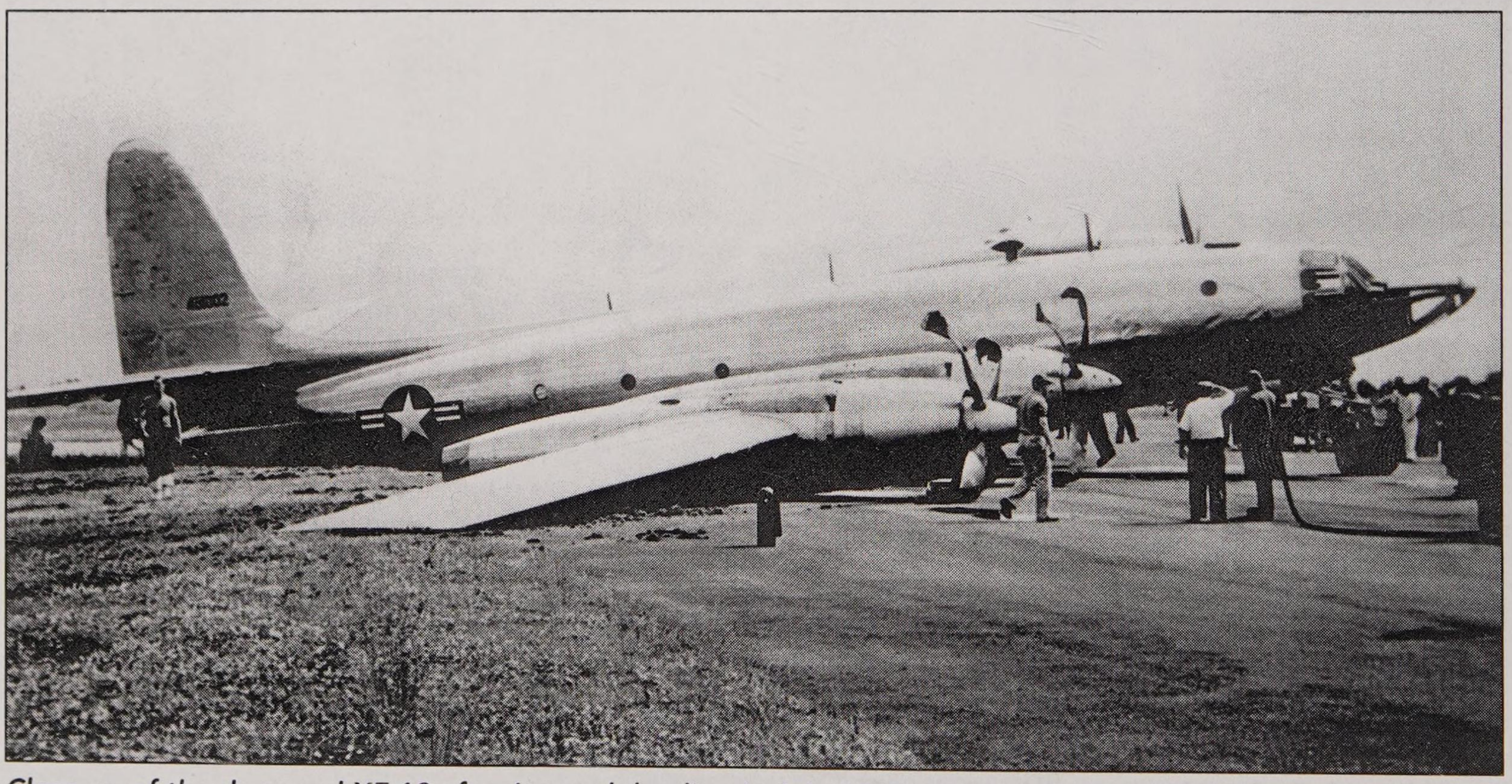
Portrait of XF-12 Ship One after its rollout, posing next to Hangar 2. This airplane suffered damage both at Republic with the hard landing, and at Wright Field where a careless tug driver rammed its vertical stabilizer into a hangar door when he missed the cut-out section provided for clearance. However, this aircraft was repaired to flyable status again after each accident. (Cradle of Aviation Museum via Dennis R. Jenkins)

propeller tips), the XF-12 leaped back into the air from the top of the bounce after impacting the runway, and commenced circling the field for four hours while it burned off the remaining fuel.

In the meantime, fire trucks, rescue crews, and other emergency vehicles were staged near Runway one-four, ready for any eventuality. After executing a stable straight-in approach from the northwest, the XF-12 gently touched down on its left main gear, and as the airspeed bled off, the ship's right wing dropped to the tarmac. As the right wingtip began scraping along the ground, the XF-12 began to decelerate more rapidly,



With company rescue crews on hand, the danger of fire was lessened, but it quickly became obvious to all in attendance that the airplane would not fly again for a significant period of time. (Cradle of Aviation Museum via Dennis R. Jenkins)



Close-up of the damaged XF-12 after its crash landing in July 1947. Note bent propeller tips, and skin wrinkles in forward fuselage. The second XF-12 prototype made its first flight one month after this incident. (Cradle of Aviation Museum via Dennis R. Jenkins)

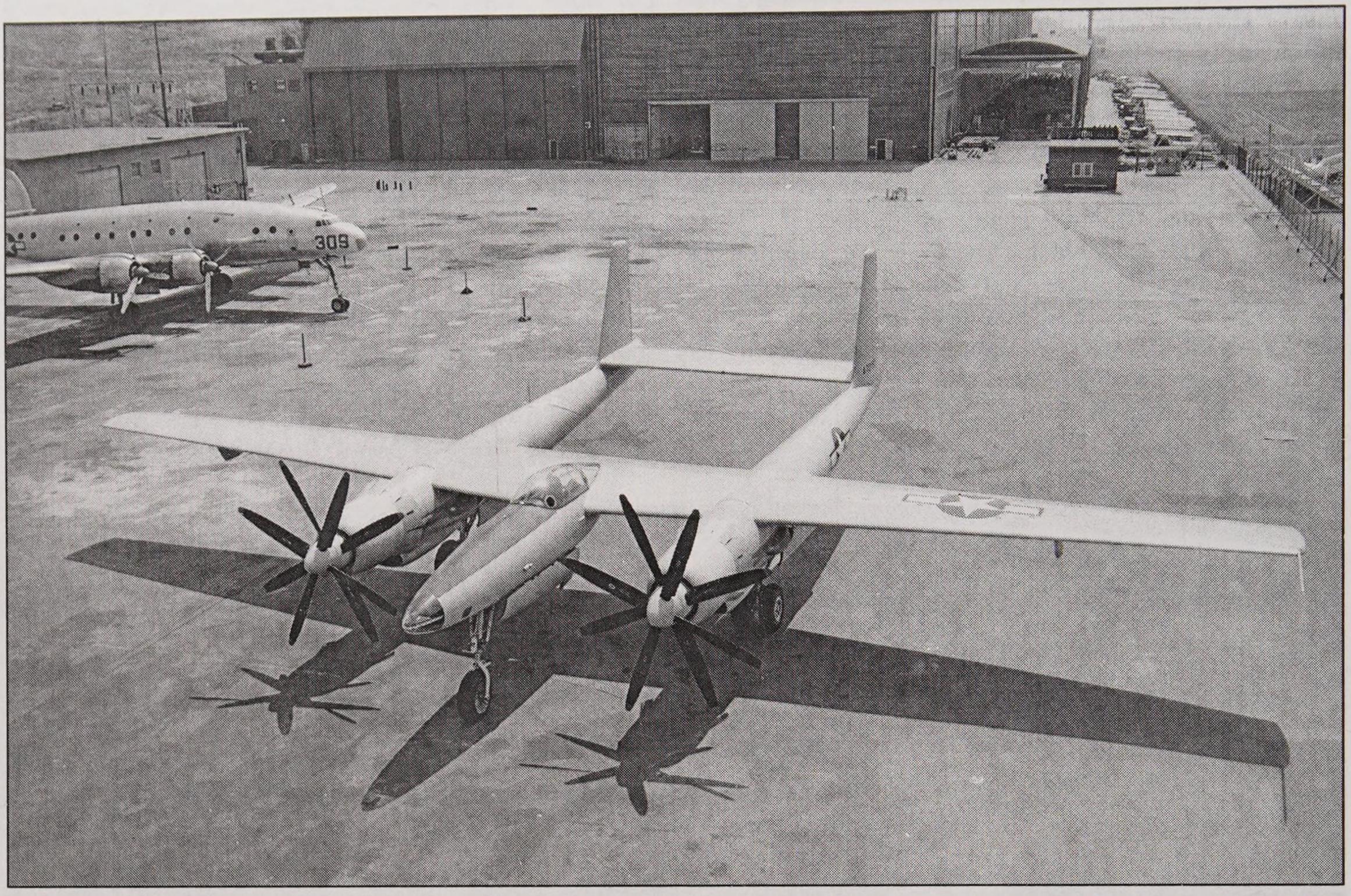
executing a graceful half-groundloop to the right, and eventually coming to rest at the edge of a midfield taxiway between Runways one-four and one-nine. Only the outer right wing, and number-three and -four engines and propellers suffered any significant damage. Repairs to the crippled craft began immediately, but the airplane remained grounded for many months.

At the time, Ship Two (S/N 44-91003) was nearing completion, nestled in the southwest corner of Republic's final assembly facility in Building 17. That airplane would be flown for the first time exactly one month and two days after Ship One's landing accident. On the West Coast, another unusual aircraft was being developed and flown by a different company trying to wrestle the crown away from Republic to win the coveted production contract for the Army Air Force's new photo-recon airplane.

Approaching Republic Field, Capt. William W. "Bill" Elliot gingerly eases the crippled XF-12 onto Runway one-four on 10 July 1947. Having sheared off the right main landing gear during a maximum-weight, maximum-sink-rate landing test, Elliot circled the airport to burn off fuel, and then began his landing. (Cradle of Aviation Museum via Dennis R. Jenkins)

"All's well that ends weil." Although the XF-12's right wing and numbers-three and -four engines and propellers were damaged, it could have been much worse. If anything, this emergency landing proved to be an unsolicited testimonial to the XF-12's ruggedness, as the impact of the initial high-sink landing could have literally torn the right wing off, surely resulting in a massive fire with a full load of fuel aboard. (Cradle of Aviation Museum via Dennis R. Jenkins)

Chapter Six



Taken in early summer 1946, this historic photo shows two ground-breaking airplanes that bore the Hughes imprint. The XF-11 (foreground) was Hughes' attempt at securing a long-term government production contract for his manufacturing company. Acquiring a commercial version of the Lockheed C-69 Constellation Army transport (upper left) was his initial attempt at conquering the world's airline industry by having the best airliner available. Two large buildings in the background were constructed for manufacturing the all-wood HK-1 flying boat. (UNLV Collection via Tony Landis)

A Competitor Emerges

While the Hughes Aircraft Company's secret DX-2 and D-5 concepts were developed in anticipation of the Army needing a high-performance photographic airplane, the XF-11 was created specifically in response to the same request for proposal and contract requirement as the Republic XF-12. However, the corporate philosophies inherent in the design and manufacturing of these two flying machines could not have been more diametrically opposed. Hughes and Republic were not only 3,000 miles apart in physical location, but were also miles apart in their approach to the challenge of developing such an exotic aircraft, and more importantly, how initial contractor flight testing of their first prototypes would be conducted.

"Twin-Motored Plastic Bomber"

Considered by many of Howard Hughes' perpetual critics as being yet another government boondoggle, the DX-2 was, in actuality, a fairly altruistic attempt to advance Army aviation. Hughes envisioned this aircraft as buttressing America's military might by providing the Army with an ultra-high-performance attack bomber that could also be adapted for photo reconnaissance. Having never built a mass-produced airplane before, he saw the development of the DX-2 as a viable way to get his foot in the door for a long-term production contract from the Army Air Corps. With his abundant financial resources, Hughes had a distinct advantage over other

contractors who were beholden to shareholders and had to use internal corporate funding for their one-of-a-kind Research and Development (R&D) proposals.

Initially referred to as the "Hughes Duramold Project," the DX-2 was controversial right from the start. In a confidential memo from the Engineering Section of the War Department dated 1 December 1941, it was determined that "The present Hughes DX-2 airplane cannot be made into a satisfactory Air Corps type." This early conclusion was based on the premise that the DX-2 lacked a number of required military features, the inclusion of which would add significant weight and complexity to the airplane, thus compromising its predicted performance capability.

Only six days later, however, the Japanese attacked Pearl Harbor and America was at war. The game had changed.

In June 1942, Chief of Staff General "Hap" Arnold penciled a memo to President Franklin D. Roosevelt that stated, "Howard Hughes . . . will send into the sky at an early date his twin-motored plastic bomber which will fly faster than any pursuit ship in the world. Mr. Hughes has put $6,000,000 of his private funds and several years of intensive work and study into the development of this plane . . ."

"What is there in this?" came FDR's cryptic reply.

Ironically, it would be Roosevelt's own son, Elliott, who would first recognize the DX-2 and a later Hughes concept as having the potential for fulfilling the Army's requirements for its high-performance photo-recon airplane. Over the next six months, volleys of correspondence between Hughes and the War Department dealt with the fact that the DX-2 design would be of benefit to the U.S. Army Air Corps. Much attention was focused on Hughes' capabilities for manufacturing large quantities of these aircraft in his limited facilities in Culver City, California, and the need for a 400,000-square-foot plant and associated equipment was identified as being paramount to the potential award of a government contract.

Preliminary performance estimates for this airplane equipped with two Pratt & Whitney R-2800-49 engines were presented to the Army as:

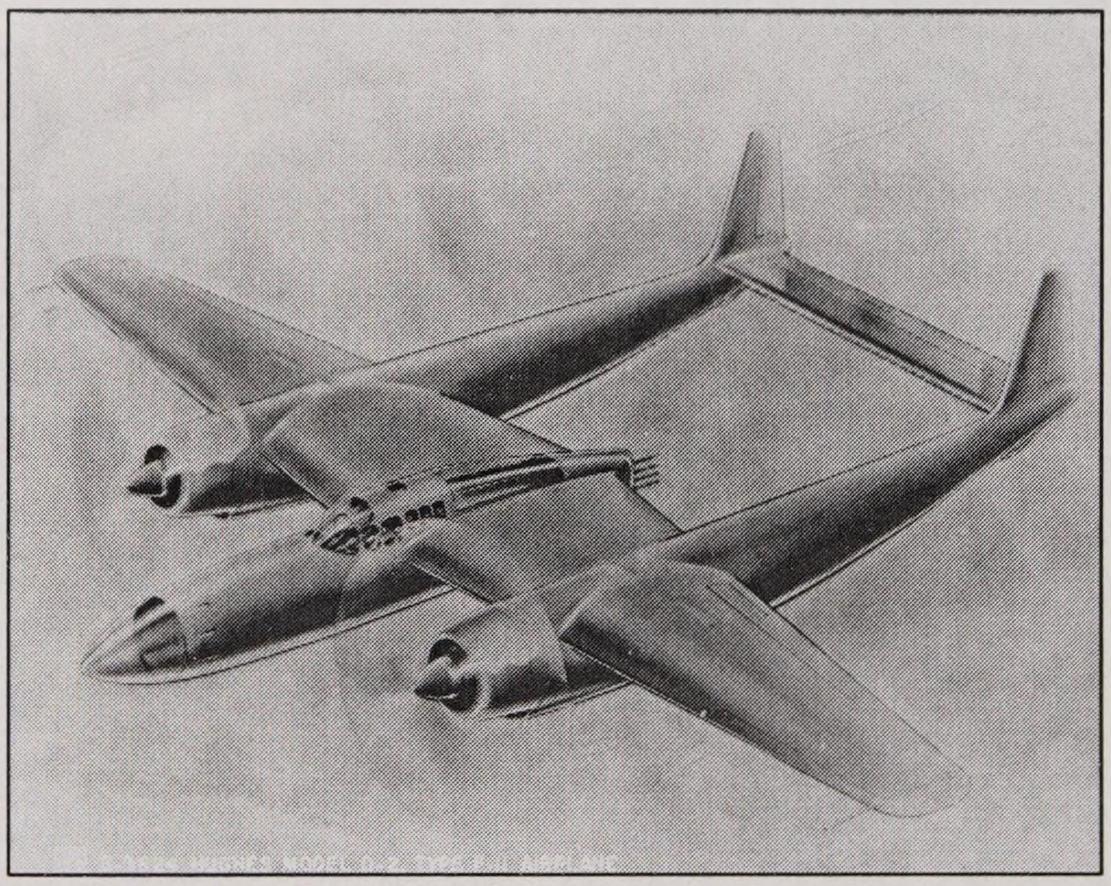
High Speed at Sea Level	368 mph
High Speed at 25,000 feet	446 mph
Service Ceiling	40,800 feet
Rate-of-Climb	3,760 fpm
Takeoff Run	1,440 feet
Gross Weight	23,900 pounds

Ultimately, the determination was made that despite its limitations, the DX-2 presented sufficient promise to warrant its procurement by the Air Corps. It was further pointed out that the Army considered the airplane to be of potential value in the study and development of both light bombardment aircraft and large wooden aircraft structures.

DX-2 — High-Speed Wooden Wonder

If all the other designations of Howard Hughes' aircraft began with the letter "H," where did the DX-2 fit into the lineup? The "D" in DX-2 stood for Duramold, which was essentially a resin-impregnated birch plywood that could be fabricated into large sheets and molded into compound curves. This manufacturing process formed the wood under high pressure, resulting in a unique material that offered an optimum combination of light weight, pliability in the forming process, and great tensile and torsional strength. An additional attribute of Duramold was its extreme aerodynamic cleanliness. Devoid of any rivets, fasteners, seams, or other mechanical protuberances, the outer surfaces of an aircraft constructed with this material were exceedingly smooth to the touch.

Although the design concept had been under some form of development since 1938, construction of the DX-2 formally commenced in April 1942 when Hughes sold his engineering data for the aircraft to the Army Air Corps for a token payment of $50. This official government transaction allowed Hughes to proceed with the project (at his own expense) as a bona fide entity for the U.S. military that could be flown and tested as such. By May 1943, the secret prototype was ready for its first flight and was transported by land to a remote desert test site at Harper Dry Lake near the small town of Hinkley, California. There, with Hughes at the controls, the DX-2 made its first flight on 20 June.



With its aft fuselage bristling with machine guns to ward off enemy attackers from the rear, this D-2 artwork gives the concept aircraft quite a sinister appearance. Cockpit was fully pressurized, and engines were Pratt & Whitney R-2800 Twin Wasps, which were to have given the D-2 a top speed well in excess of 400 mph. Complex cockpit canopy framework, coupled with the large wing and engine nacelles, would have severely limited pilot visibility. (National Archives via Dennis R. Jenkins)

Initial evaluation of the aircraft's handling characteristics indicated serious airflow problems with its high-aspect-ratio laminar-flow wings, and Hughes was not pleased that all of this work had resulted in such an inferior airplane. After design modifications were made to the wings, Hughes flew the DX-2 for a second time on 2 August 1943, but plans were already underway for a larger successor aircraft, and despite subtle improvements in its handling, the DX-2 was never flown again after that day.

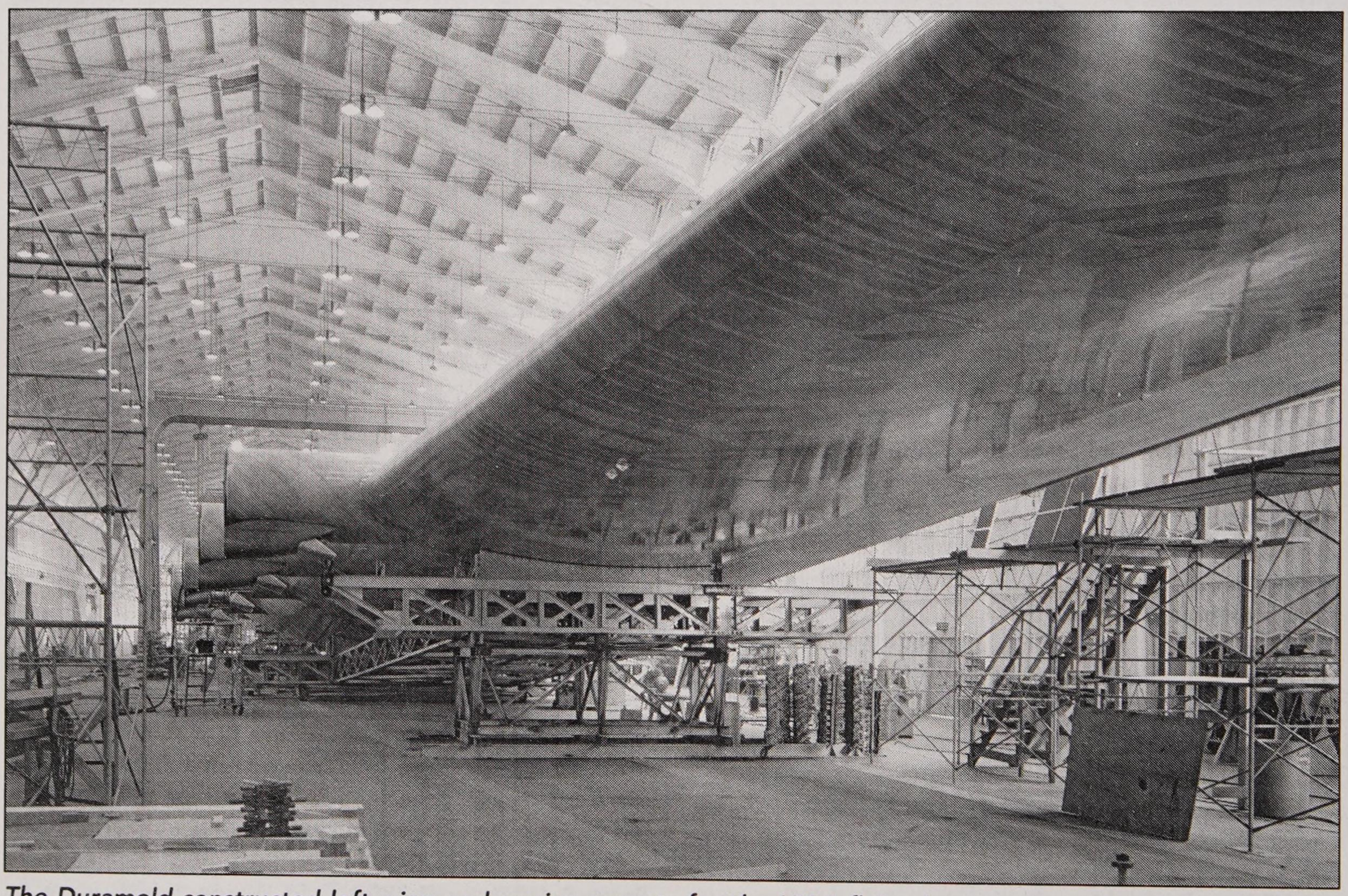
Almost as a harbinger of the giant Hughes HK-1 flying boat being flown only once and then sequestered in an air-conditioned, humidity-controlled hangar in November 1947, the DX-2 was stored in a similar structure at the Harper site never to be seen again. It remained concealed there until a mysterious hangar fire, allegedly from a desert lightning strike, destroyed it in November 1944. The high-speed wooden wonder Hughes had envisioned as becoming the world's highest-performance piston-powered airplane was reduced to burned-out rubble. From these ashes, however, a larger and even more capable airplane would rise.

D-5 — A Critical but Elusive Step

Resembling a larger and more robust version of the DX-2, the D-5 was conceived as a long-range, high-speed, high-altitude medium bomber as well as a photo-reconnaissance aircraft. As stipulated in a confidential memorandum from the USAAF Engineering Technical Section at Wright Field in July 1943, the D-5 specifications would call for an airplane weighing 36,000 pounds at takeoff with an overall wing area of 750 square feet. Its cockpit would be pressurized, and powerplants would be two Pratt & Whitney R-2800 Double Wasp radial engines. The aircraft's "bomb load" would consist of either two 2,000-pound bombs or one 4,000-pound bomb.

With a two-thirds fuel load, armor protection for the pilot and co-pilot, but no guns or armament, the aircraft's estimated performance characteristics were described as:

Maximum speed at 30,000 feet	488 mph
Maximum speed at 36,000 feet	451 mph
Optimum Cruising Altitude	32,000 feet
Range at Optimum Cruising Altitude	3,600 miles
Rate-of-Climb at Sea Level	2,040 fpm



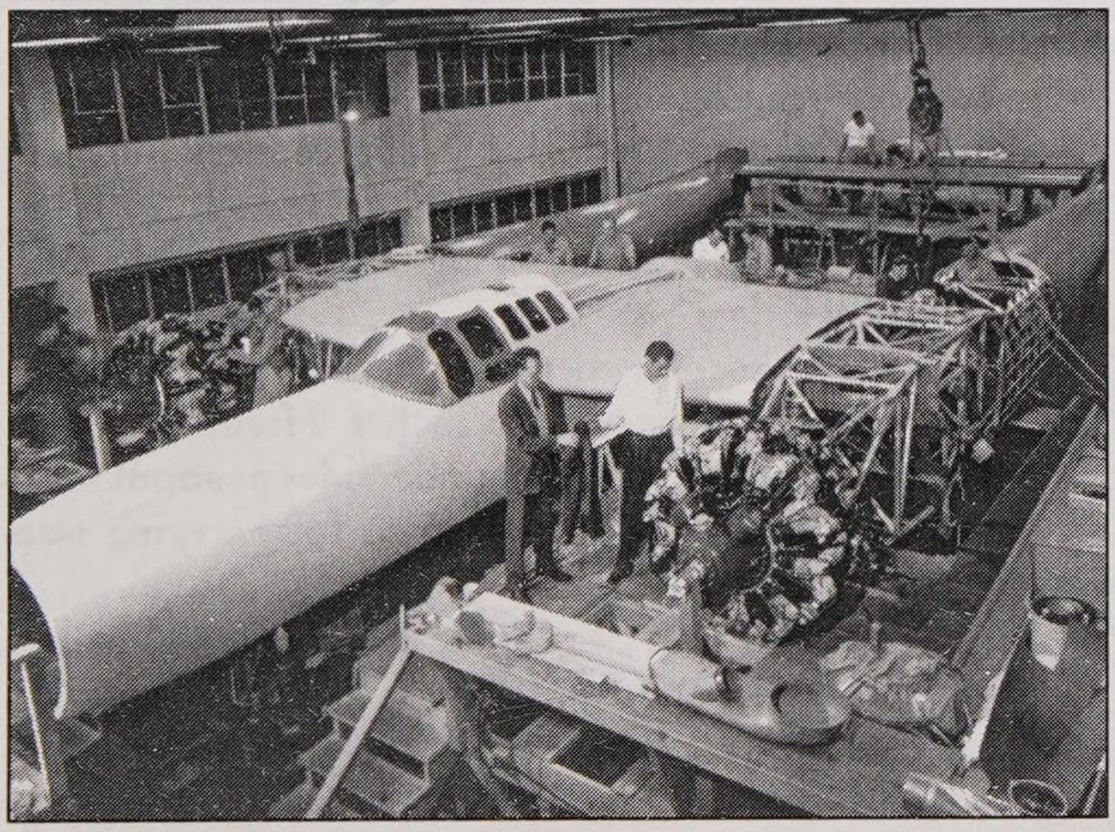
The Duramold-constructed left wing and engine mounts for the HK-1 flying boat are completed and ready for painting in the specially built Hughes facility at Culver City. Note the obvious wood-grain patterning and porcelain-smooth finish of the external surfaces. As this book was going to press, a $50 million renovation of this cavernous building was announced that will create multiple sound stages for movie and television production. This will be one of the final stages in the Playa Vista development project that now occupies the former Hughes Airport. (UNLV Collection via Tony Landis)

Hughes' goal of finally mass-producing a military airplane seemed to be within reach when he was informed of an impending provisional contract to build 13 pre-production D-5 prototypes. Estimated cost of facilities and equipment required to manufacture these 13 test aircraft was $970,000, with three months being stipulated as the time for completion of the manufacturing facilities and their installations. Delivery of the first D-5 prototype was expected to be made six months after completion of these facilities, with the 13th and final test airframe coming off the line nine months later.

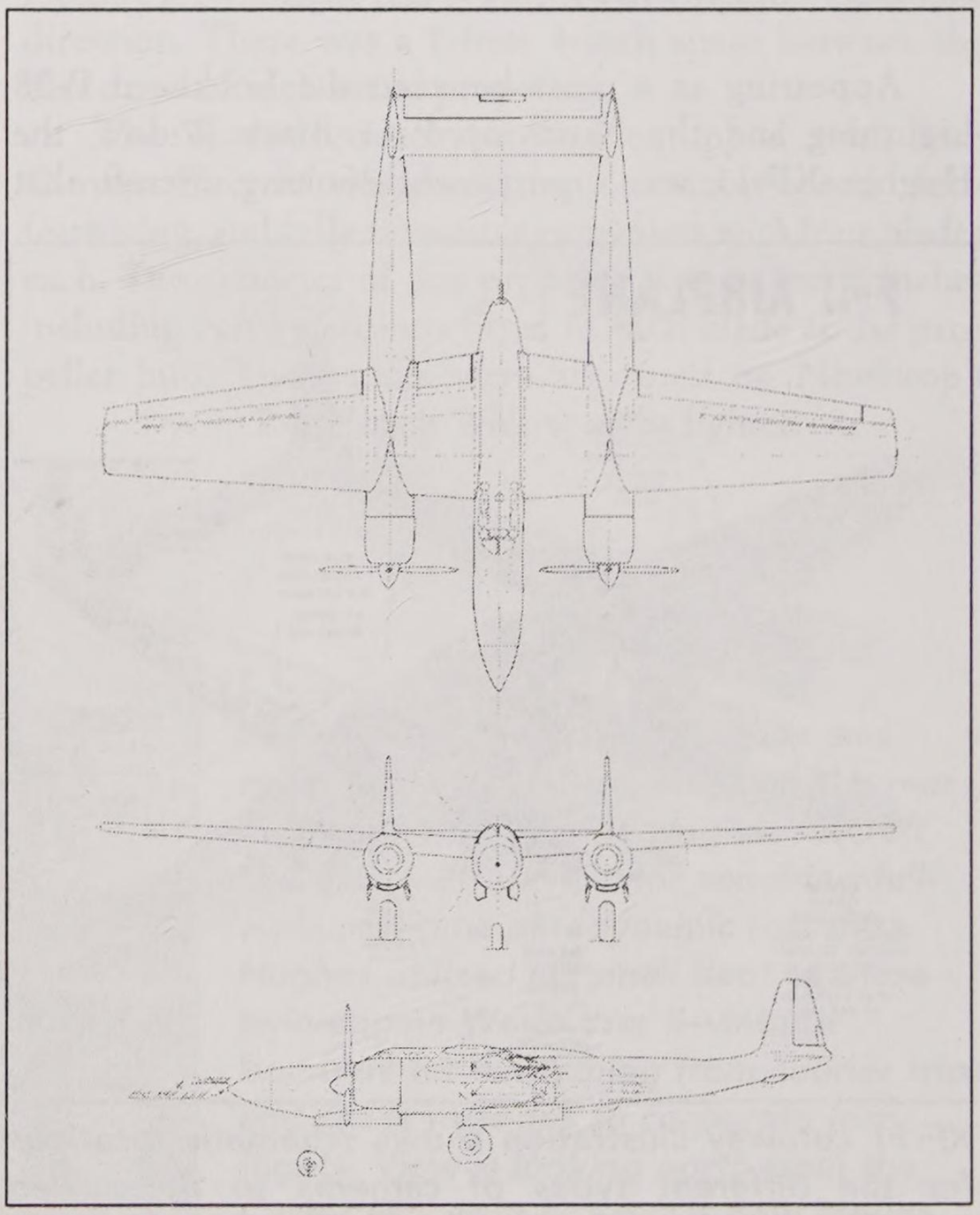
At Wright Field, other factions in the Army's Materiel Command were examining a new design from Lockheed as the aircraft best suited to its requirements for the photo-recon mission. Called the XP-58 Chain Lightning, this two-seat, twin-tail-boom design was a larger outgrowth of the famed P-38 Lightning, and offered a multi-role mission capability. Like the D-5, the XP-58 was to have been powered originally by two 2,350-hp Wright XR-2160 Tornado engines, but myriad delays and problems with these complex 42-cylinder powerplants ultimately led to the use of turbo-supercharged Allison V-3420 engines. However, between the Army's ever-changing mission requirements and Lockheed's own development problems, the XP-58 never reached production, with only a single prototype being built and flown on only 26 flights.

Meanwhile, back at the Pentagon, a committee of military photo-reconnaissance experts comprised of Col. Roosevelt and five other staff officers set out on a national inspection and fact-finding tour in August 1943. Their task was to gather as much information as possible on the two different manufacturing companies and their associated aircraft in order to identify the best candidate for the Army's desired high-performance photo airplane. Stops included Lockheed's Burbank plant, the Hughes Culver City facility, Lockheed's modification center in Dallas, and headquarters of the Army's photo-recon training program at Peterson Field in Colorado Springs. The committee's finding indicated that the Hughes D-5 was the airplane they considered most suitable for the long-range photo-reconnaissance mission.

In October 1943, the USAAF issued a Letter of Intent to the Hughes Aircraft Company indicating the purchase of an all-metal production version of the D-5, to be powered by Pratt & Whitney R-4360 engines and called the XF-11. The fixed-price contract would be for the manufacture of 100 airplanes at a cost of $48,555,000. However, as development program delays began to mount in the following year, it became readily apparent to the Army that the Hughes team lacked the necessary management assets, experience with metallurgy and manufacturing methodology, and physical plant facilities in which to build 100 F-11A production aircraft on a demanding schedule. By spring 1945, another even larger challenge to the Hughes airplane was beginning to emerge.



This often-seen factory photo is one of the few images documenting the actual construction of the twin-engine Duramold-built D-2. Howard Hughes (in white shirt) can be seen handing his jacket to his friend and long-time engineer Glenn Odekirk as he prepares to inspect the aircraft's number-one engine installation. Note finished external skin sections of the aircraft, completely devoid of any Cleco fasteners as would be seen on a riveted metal airplane at this stage of construction. (UNLV Collection via Tony Landis)



Three-view drawing of the Hughes D-5 shows similar proportions to the smaller DX-2, but with provisions for more armament and defensive capability. This design, although never built, proved to be the necessary stepping stone to the XF-11. (National Archives via Dennis R. Jenkins)

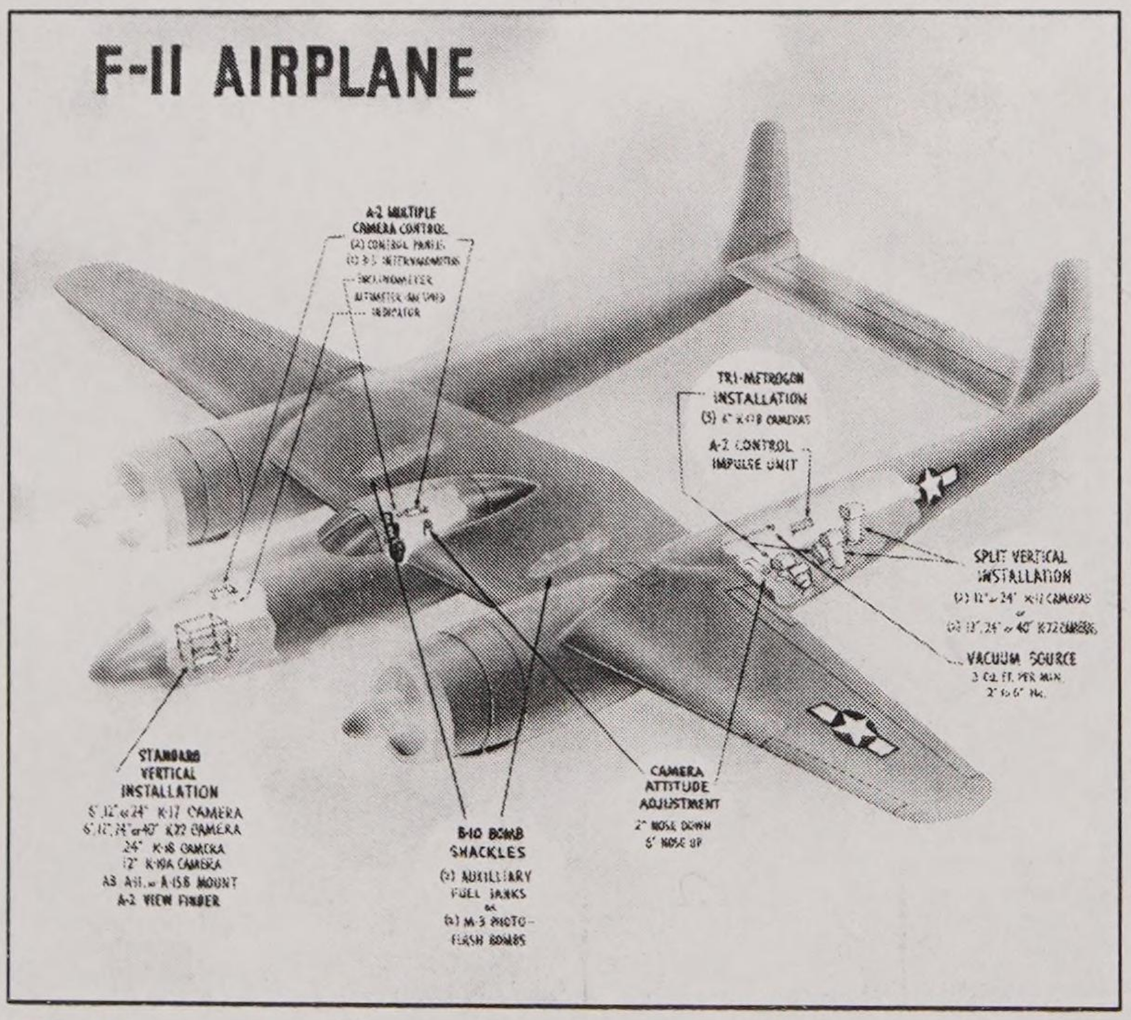
With the end of World War II in sight, the need for the XF-11's long-range photo mission was rapidly diminishing, and the production contract for 100 operational aircraft was changed to the construction of only two experimental prototypes to be flown strictly for development work. With the end of the war in August that year, and no more need for either his photo airplane or the HK-1 troop transport, Howard Hughes' hopes for building his company into a major government contractor were dashed.

The following table compares the general specifications and design details of the three twin-engine Hughes photo-recon aircraft:

	D-2A	D-5	F-11
Gross Weight (pounds)	30,000	40,000	50,000
Powerplant	R-2800	R-2800	R-4360
Length (feet)	34	58	65
Span (feet)	61	92	101
Construction Materials			
Fuselage	Wood	Wood	Metal
Wings	Wood	Metal	Metal
Tail booms	Wood	Metal	Metal

XF-11 — The Mystery Ship

Appearing as a cross between the Lockheed P-38 Lightning and the Northrop P-61 Black Widow, the Hughes XF-11 was a purposeful-looking aircraft that seemed ahead of its time for a mid-1940s design. Unlike the Duramold-constructed DX-2 and D-5 concepts, this airplane was built with a semi-monocoque, flush-riveted, Dural 75ST aluminum alloy structure.



XF-11 cutaway illustration shows schematic locations for the different types of cameras to be carried onboard. Unlike Republic's XF-12, there were no provisions for either servicing the cameras or developing any film onboard the aircraft while it was in flight. Also unlike the XF-12, there were no provisions for carrying photo flash bombs to allow nighttime reconnaissance. (National Archives via Dennis R. Jenkins)

Fuselage

In contrast to the Republic airplane, the XF-11 was completely devoid of a standard-type barrel-section fuselage. Replacing that structure was a small streamlined pod affixed to the upper leading edge of the center wing section that housed an entry hatch on its aft underside, and a fairly roomy two-man cockpit above. The cockpit was pressurized to 10,500 feet at an actual altitude of 30,000 feet with the crew housed under a single, large, fixed-bubble canopy. The pilot sat in the forward position with the navigator/photographer sitting behind and to the right, who would be called upon to crawl forward into the nose to service the cameras while in flight.

The wing was connected to the tail section by two large fuselage booms extending aft from the twin engine nacelles, with each boom extending upward into a vertical stabilizer. Overall length from nose to tail was 65 feet 5 inches.

Wing Design

With a span of 101 feet 4 inches and an area of 983 square feet, much like the XF-12, the XF-11's wing dominated the airplane's shape in plan view. Its mean aerodynamic chord (defined as the average distance from leading to trailing edge measured parallel to the line of flight) was 124.7 inches. Wing loading was 59 pounds per square foot at a gross weight of 58,315 pounds. Both leading and trailing edges were perfectly straight from root to tip with a 2-degree angle of incidence at the root and a dihedral of 1 degree and 29 minutes. Sweep back at the wing leading edge was approximately 7 degrees.

The wing's chord at the root was 168 inches, while the chord at the wingtip was 68 inches. Hardpoints and pylons were affixed to the wing undersides at about one-third span inboard from the wingtips for carrying two 700-gallon auxiliary fuel tanks.

Provisions for carrying two additional 600-gallon auxiliary fuel tanks mounted on the XF-11's wingtips were indicated on factory engineering three-view drawings, but neither prototype ever flew in that configuration.

Single-slotted Fowler flaps were attached to the wing trailing edge for enhanced stability at lower airspeeds. A row of thin-chord spoilers located at mid-span on the wing's trailing edge immediately forward of the flap hinge line were employed in place of ailerons for primary roll control at higher airspeeds. Small-width ailerons were installed at the trailing edge of each wingtip to augment roll control authority at lower airspeeds during takeoff and landing, or when the aircraft was flying at a high angle-of-attack.

Tailplanes

A single, fixed, horizontal stabilizer was mounted between and at the extreme aft ends of the XF-11's twin tail booms with a single elevator assembly attached to the trailing edge of the horizontal stabilizer. Span of this assembly was 25 feet 8 inches measured from the inboard surfaces of the tail booms at the stabilizer leading edge. Area of the horizontal stabilizer and elevator assembly was 240 square feet.

The XF-11's twin vertical stabilizers were attached to the extreme aft ends of the twin tail booms, mounted flush with the outboard external surfaces. A rudder and trim tab assembly was attached to the trailing edge of the vertical fins. Chord of this assembly at the root was 11 feet 2 inches wide, while the top of both vertical fins was 23 feet 3 inches above the ground line. Area of the vertical stabilizer and rudder assembly was 151 square feet, and both the elevator and rudders featured sealed internal counterbalances for optimum aerodynamic efficiency.

Although an anti-icing system was originally considered for the XF-11, neither prototype was equipped with one. Fitting the airplanes with either external flush-mounted de-icer boots or internally routed engine bleed air was deemed by Hughes engineers as being too complex and problematic, and cause for significant delay. By special written amendment, the Army Air Forces contract stipulated that in light of the limited test nature of the prototypes, flight operations would be conducted primarily in day VFR (Visual Flight Rules) conditions, and therefore no anti-icing system would be required.

Powerplants

From first inception of its design, the XF-11 was to be powered by two Pratt & Whitney 28-cylinder R-4360 Wasp Major radial engines. Each engine's thrust was boosted by twin General Electric BH-1 turbosuperchargers with their exhaust gases exiting through two seperate exhaust ports. These were located on the inboard and outboard sides of each tail boom below the wing and immediately aft of the engine nacelle. The XF-11's engines, the same -31 model of the R-4360 radials as on the XF-12, were shown to have different power ratings for the twin-engine Hughes aircraft. These engines developed 3,000 hp at 2,700 rpm at sea-level takeoff, and 2,500 hp at 2,550 rpm at 33,000 feet, although they were structurally identical to the R-4360-31 engine used on the competing Republic airplane. Military power ratings were 3,000 hp at 2,700 rpm at 33,000 feet.

Propellers

Two-each Hamilton-Standard super-hydromatic, dual-rotation, constant-speed, full-feathering, and fully reversible propellers with a total of eight blades were fitted to the first prototype. It is interesting to note that the diameters of the front and rear set of blades were slightly different from each other, with the front set having a diameter of 15 feet 1 inch, and the rear set having a diameter of 15 feet 3 inches. Additionally, the front set of propellers turned in a clockwise direction when viewed looking forward; the rear set turned in a counter-clockwise direction. There was a 1-foot 4-inch space between the blade tips of each set of propellers.

The second prototype was equipped with two Curtiss Electric single-rotation, constant-speed, full-feathering, and fully reversible propellers with four blades each. The diameter of this propeller was 14 feet 8 inches including cuff extensions fitted to each blade at the propeller hub. These units were also used on Northrop's P-61 Black Widow night fighter.

Full-size XF-11 vertical stabilizer and rudder assembly is mounted on the rear fuselage of one of the Hughes Aircraft Douglas A-20 Havocs for acquiring full-scale real-time aerodynamic test data. Hughes utilized his small fleet of these twin-engine World War II–vintage bombers for everything from courier trips and chase missions to corporate ferry flights. View is looking north from the Culver City strip at what is now Marina del Rey, California. Note small gust lock at base of rudder, and the prominent "EXPERIMENTAL" placard placed on the aircraft's lower fuselage. (Craig Kaston Collection)

Landing Gear

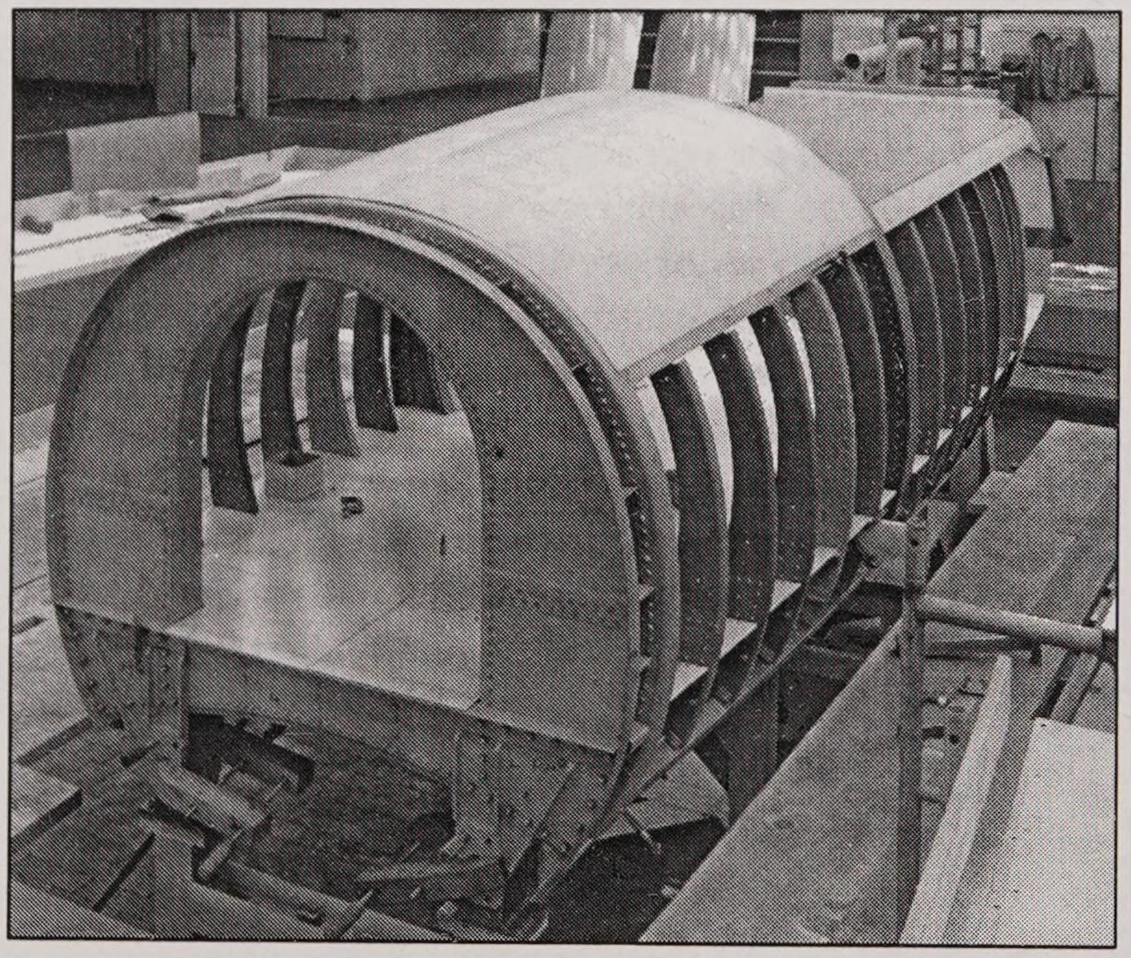
Like the Republic XF-12, the Hughes airplane featured fully retractable tricycle landing gear. The nose landing gear was comprised of a single 40-inch-diameter nose wheel mounted on a left-hand fork axle below a single long strut emanating from the fuselage directly aft of the nose camera compartment. Vertical shock absorption was accomplished by the use of a single oil-filled-piston shock absorber. This landing gear assembly retracted aft into its bay on the underside of the forward fuselage and was locked into position when in flight. The nose gear was fully enclosed by two large clamshell doors that covered the entire wheel and strut assembly when the gear was retracted.

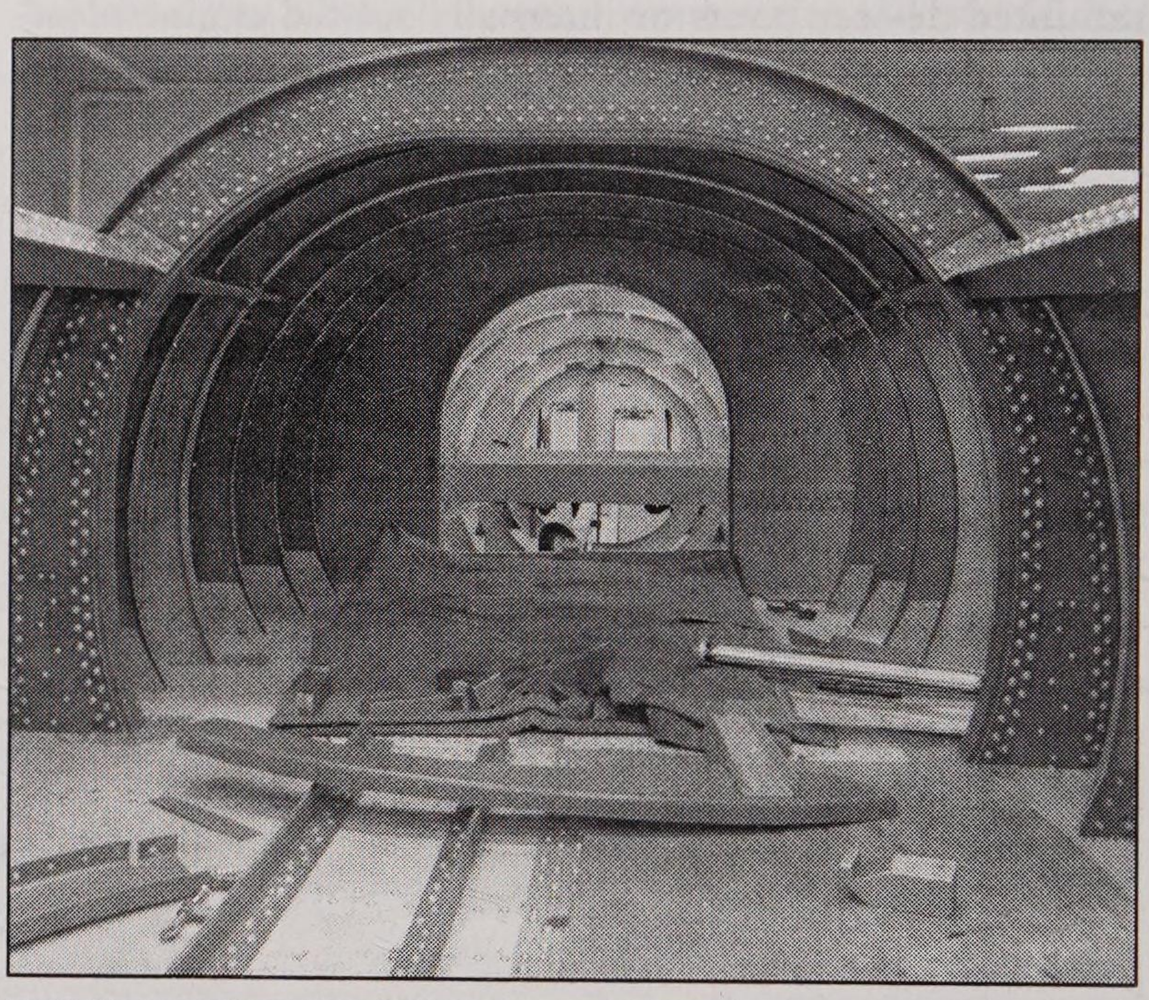
The XF-11's main landing gear was comprised of twin 44-inch-diameter mainwheels mounted on an axle below a single strut emanating from the underside of each tail boom immediately aft of the turbo-supercharger exhaust port. Vertical shock absorption was accomplished by the use of a single oleo-and-scissor oil-filled-piston shock absorber. Gear retracted aft and was fully enclosed by two large clamshell doors, and was locked into position when in flight. The tread of the main landing gear was 29 feet wide, and wheelbase from nose wheel to mainwheels was 19 feet 7 inches.

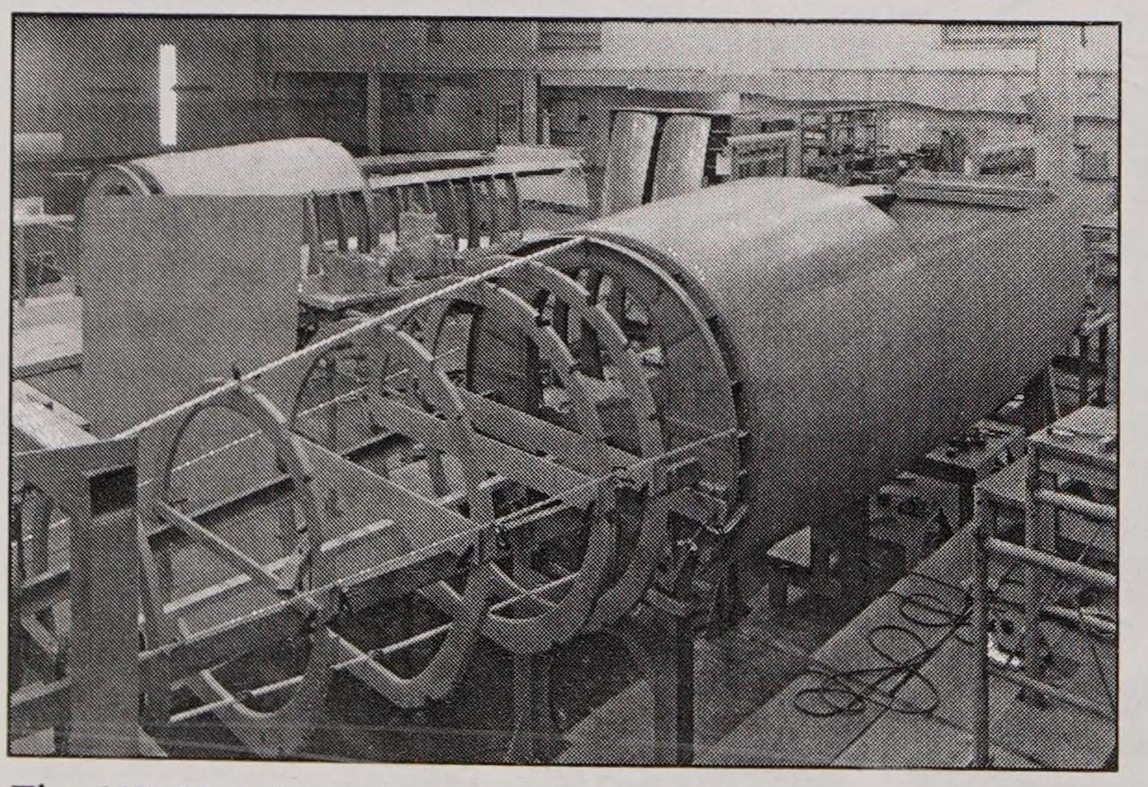
Operational Systems

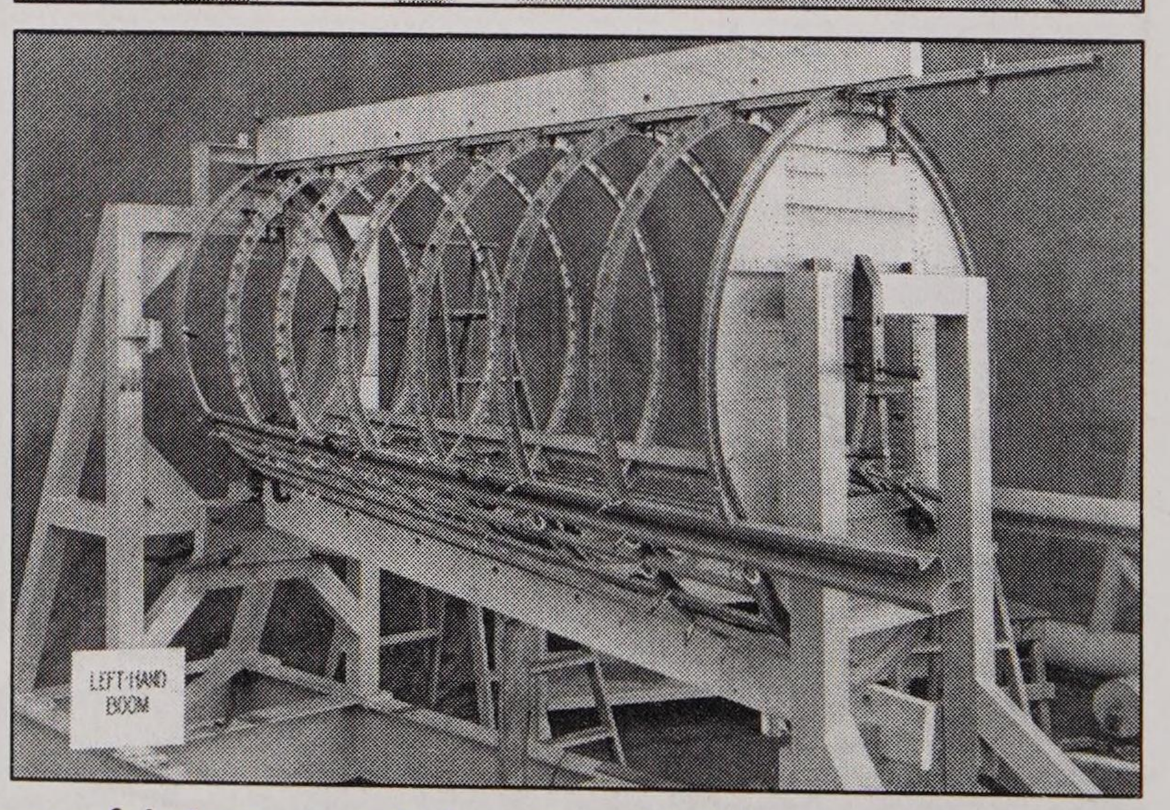
In addition to the standard USAAF Customer Furnished Equipment flight and engine control instrumentation installed in the XF-11 cockpit, the aircraft contained four type "D-2" low-pressure oxygen cylinders. The XF-11's long-range navigation and communications suite included the following equipment:

- SCR-522 Radio Set
- SCR-695 Radio Set
- RC-36
- RC-198
- BC-348
- AN/APS-13 & SCR-718-A System
- Radio Localizer Receiver
- AN/ARN-7 (SCR-639) Glide Path Receiver
- RC-193 Marker Beacon Receiver
- Radio Altimeter

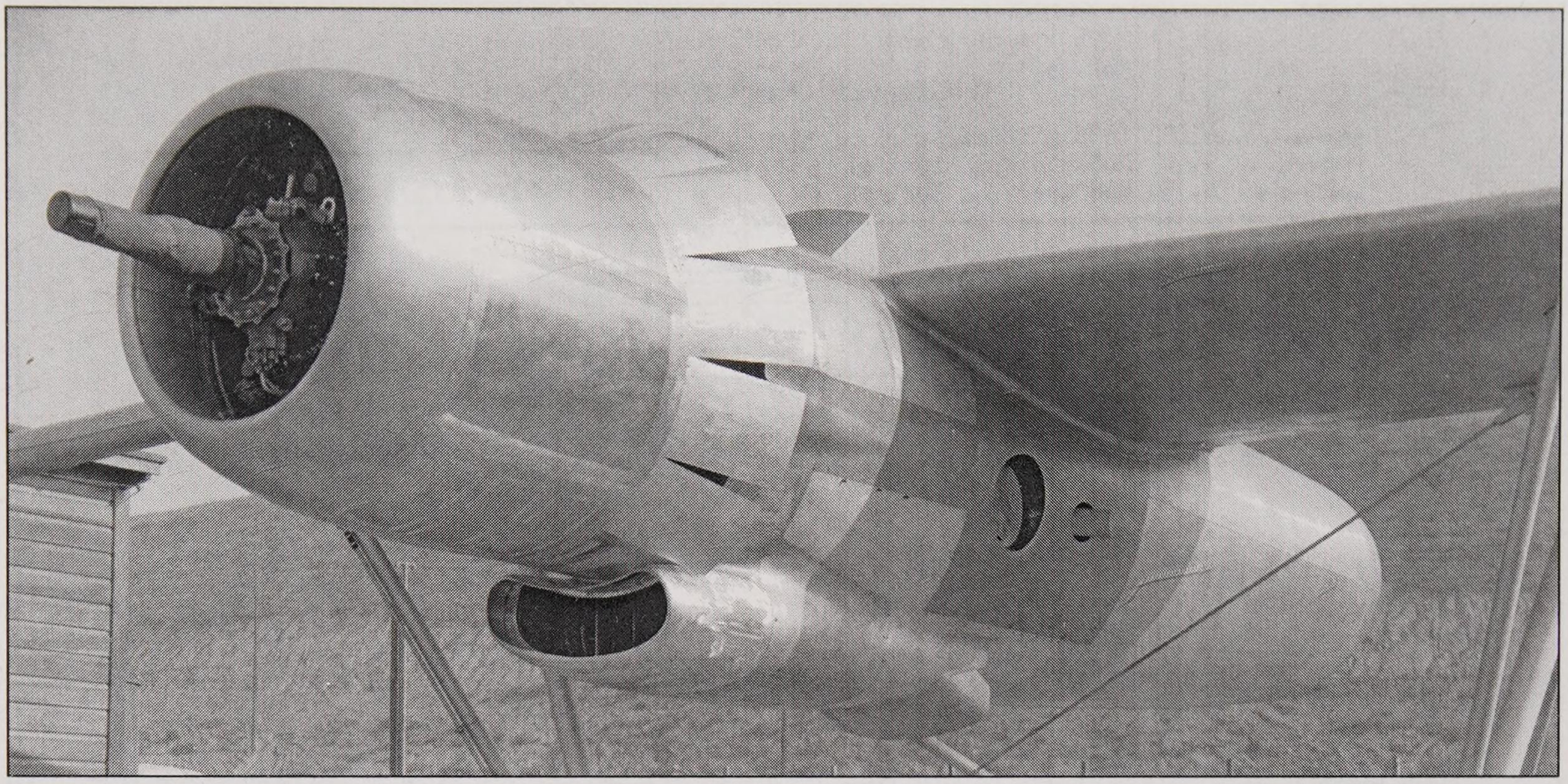




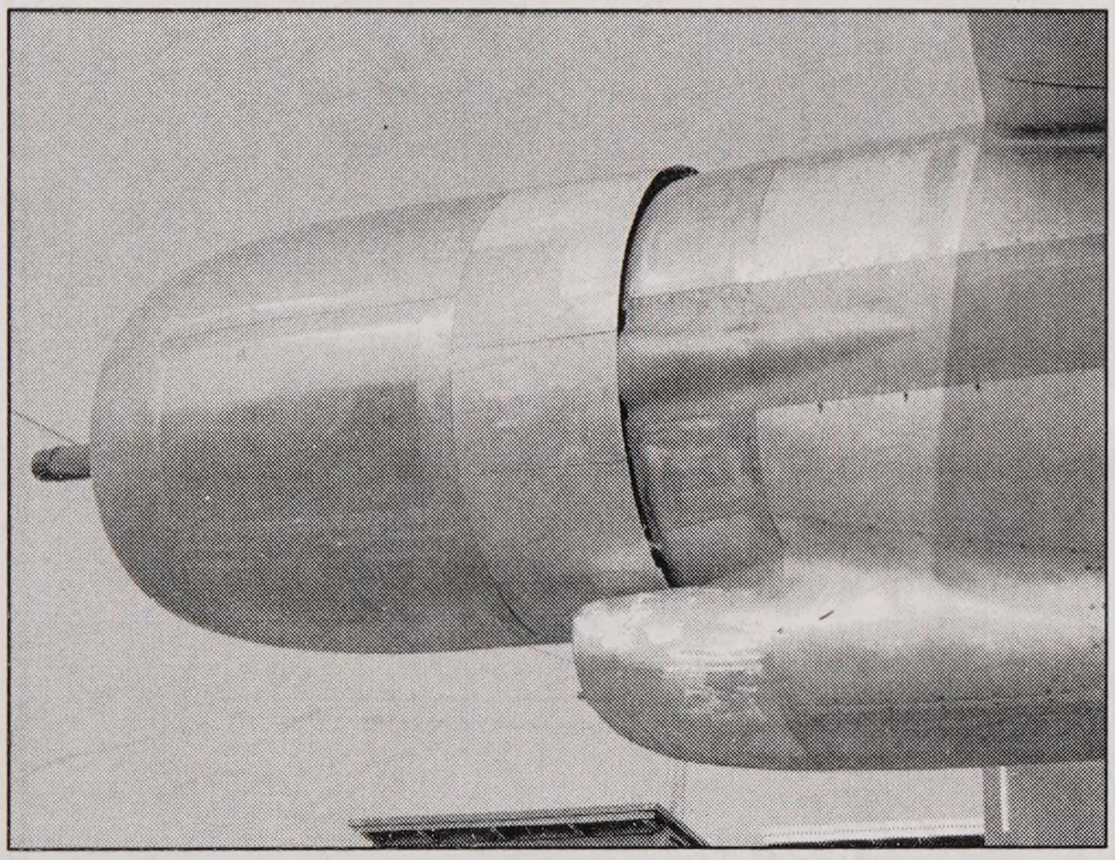


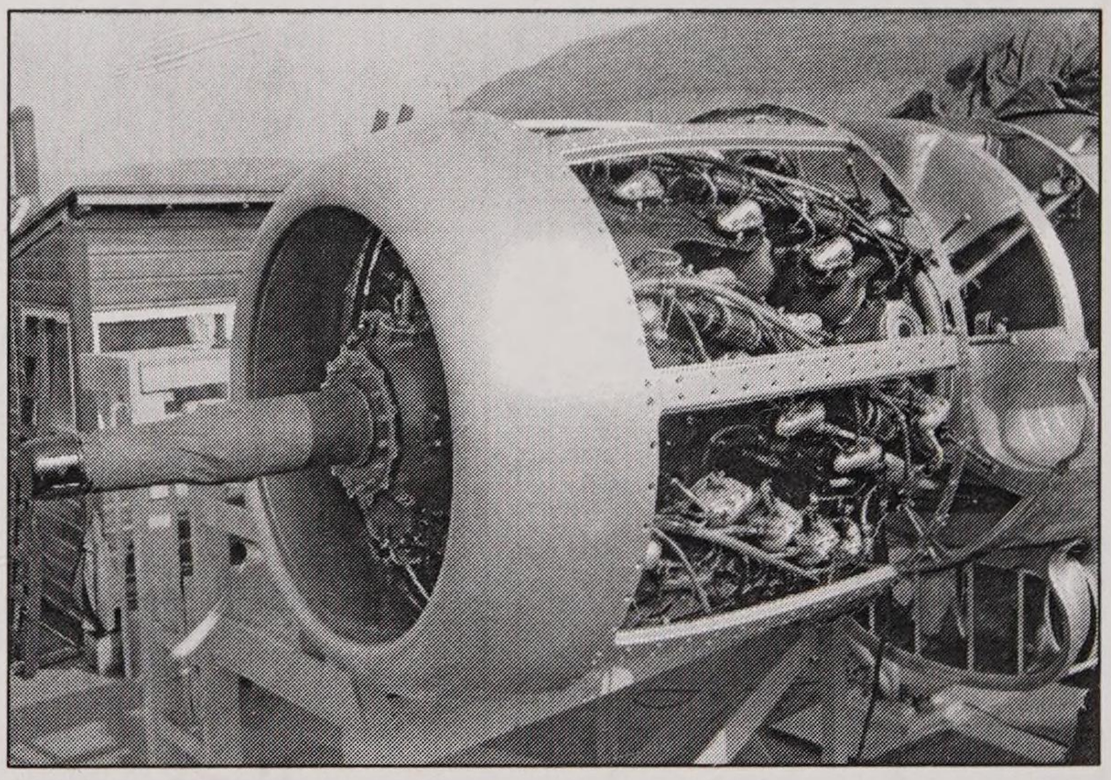


The XF-11 takes shape as various structural components are fabricated at Culver City. Visible here are the forward tail boom, cockpit and nose section, and aft tail boom in various stages of construction. The meticulous craftsmanship of Hughes workers is evident. (National Archives via Dennis R. Jenkins)

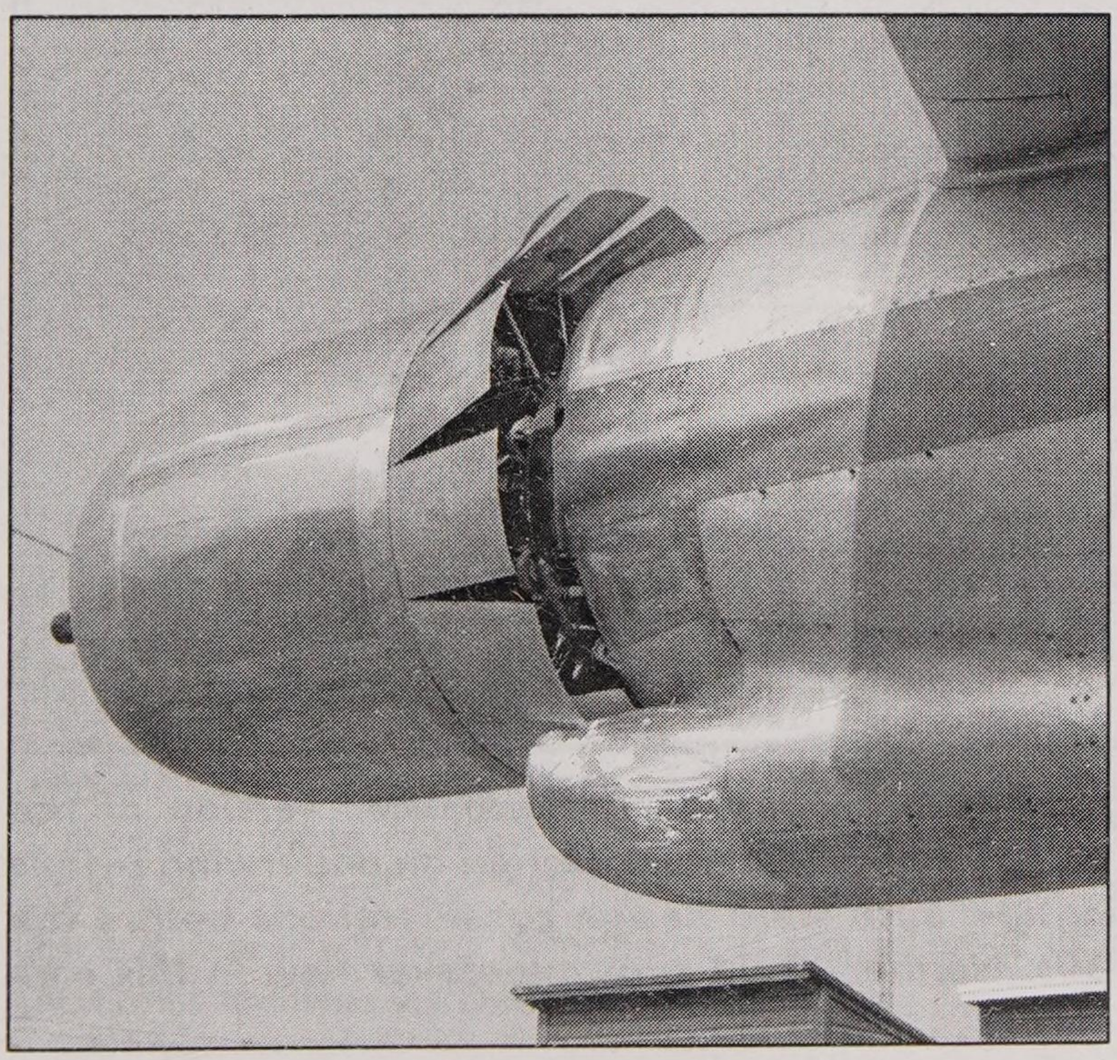


Complete XF-11 test nacelle including wing box and forward tail-boom structure. (National Archives via Dennis R. Jenkins)





XF-11 nacelle structure mounted on a test stand at Culver City, with actual R-4360 engine inside and three of the engine's four rows of seven-cylinders—each visible through the open access panels. (National Archives via Dennis R. Jenkins)



Rear-three-quarter view of the test-stand engine rig with cowl flaps closed (top) and open (bottom). (National Archives via Dennis R. Jenkins)

HUGHES AIRCRAFT CO.

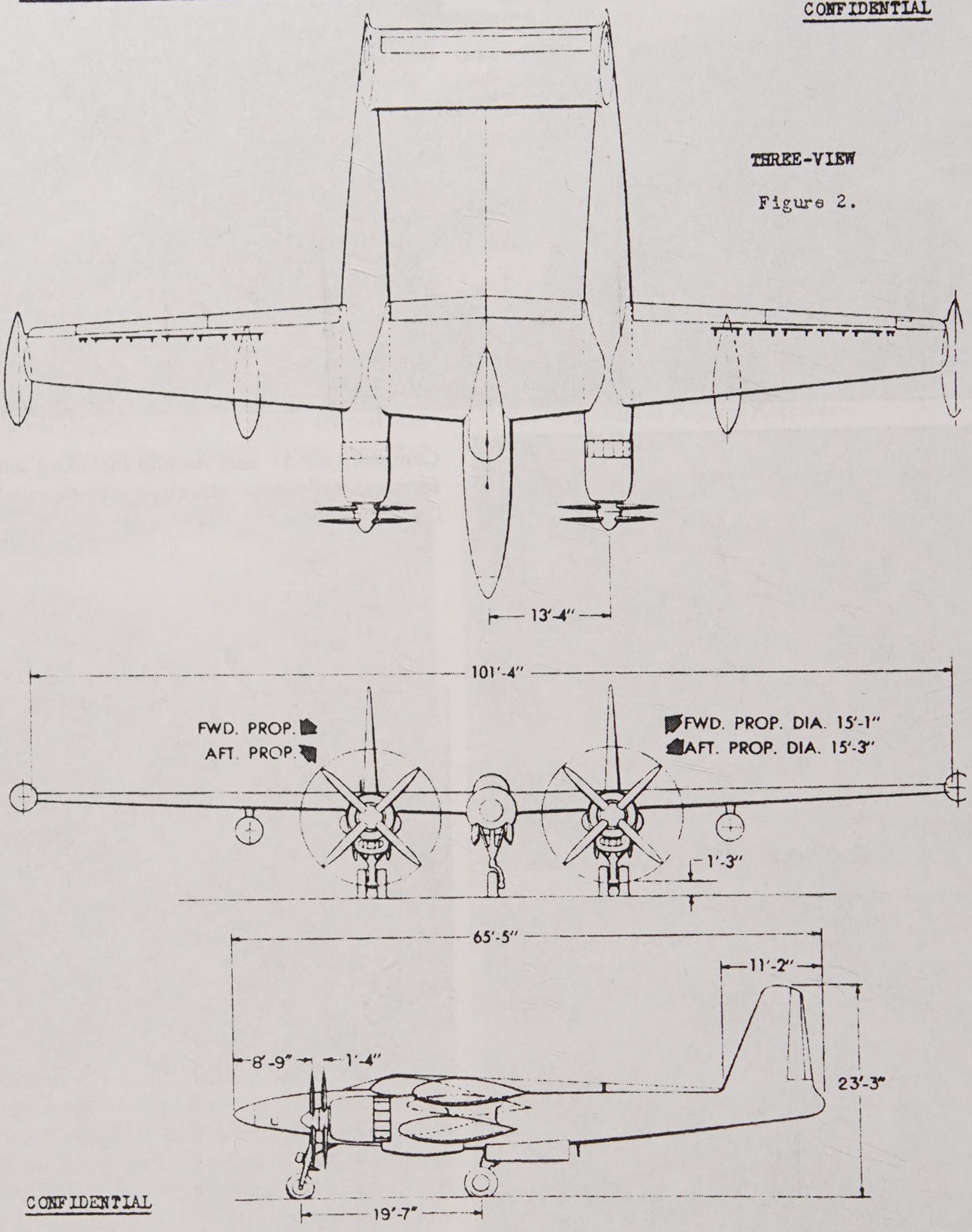
ANALYSIS Three-View Drawing MODEL XF-11 Mod. A REPORT NO 01-210-A PAGE 4

PREPARED BY W. H. McLauchlan 10/1/47

CHECKED BY E. C. Wodrich 10/1/47

PERFORMANCE

CONFIDENTIAL

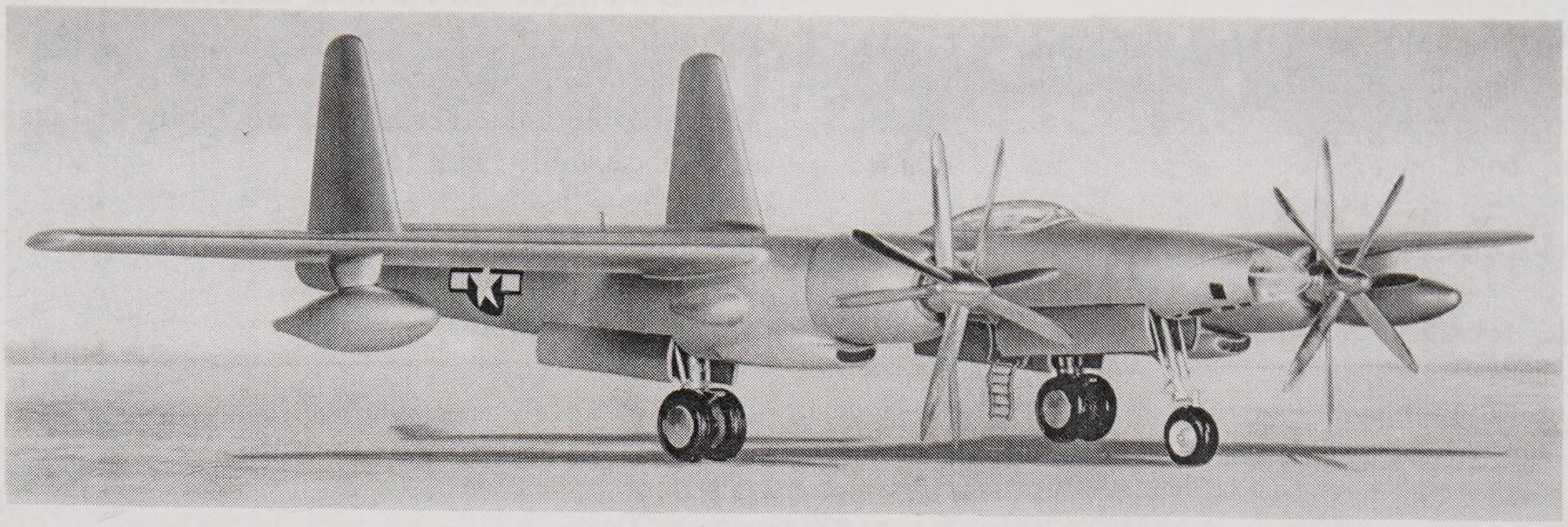


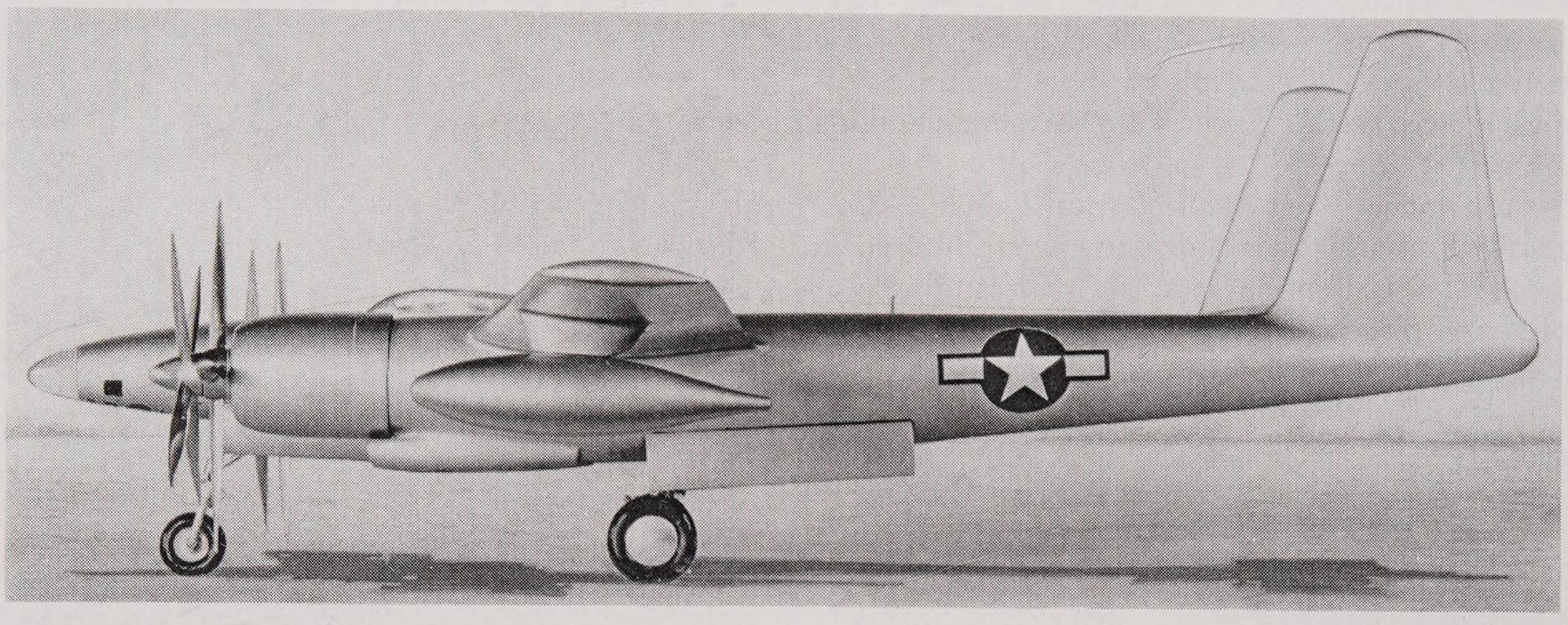
THREE-VIEW

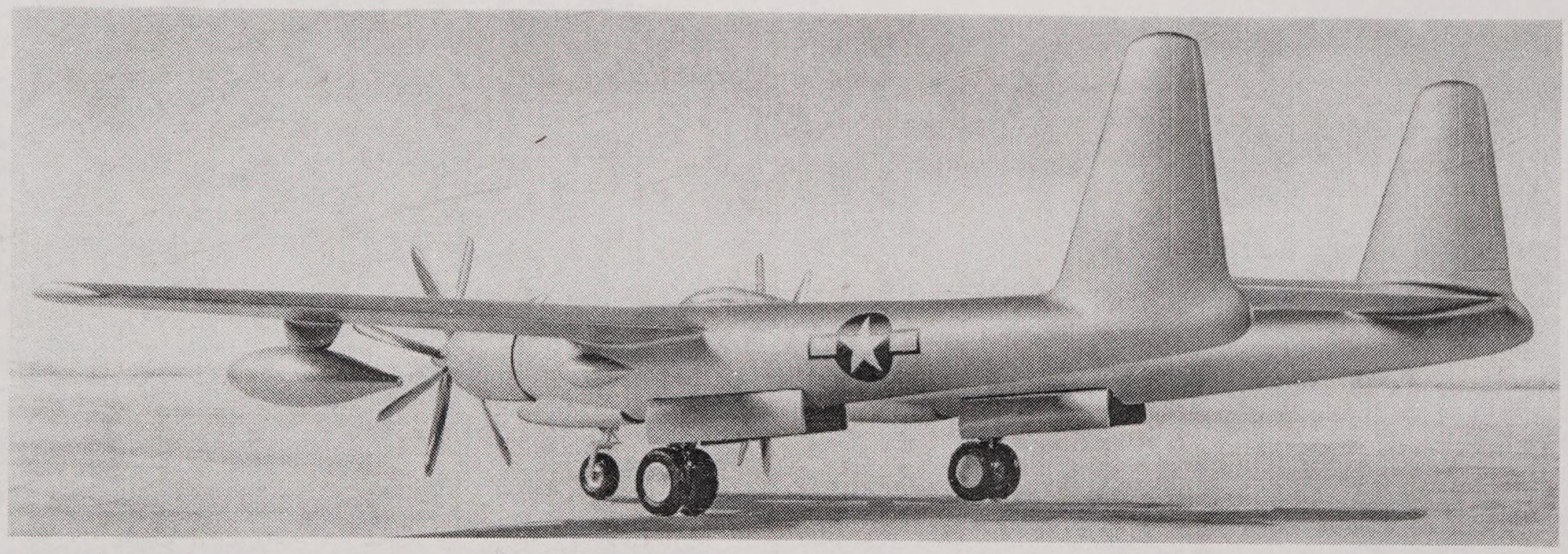
Figure 2.

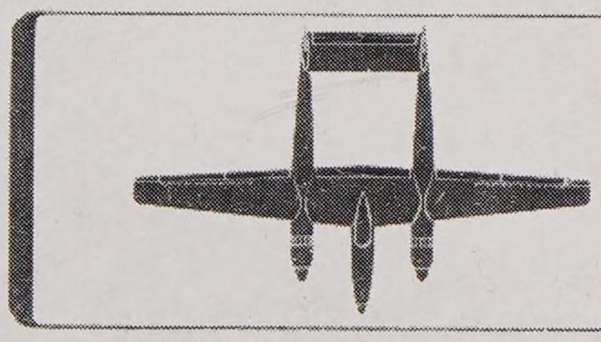
CONFIDENTIAL

Official Hughes Aircraft Company three-view drawing shows a proposed "Performance" version of the XF-11 equipped with external auxiliary fuel tanks—one pair of 700-gallon tanks carried on underwing pylons and two 600-gallon tanks mounted on the aircraft's wingtips. Such were design considerations before the advent of operational inflight refueling in the early 1950s. Neither XF-11 prototype ever flew in this configuration, however. (National Archives via Ryan Crierie)







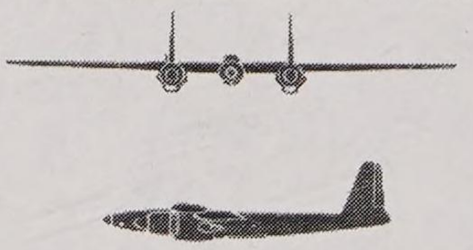


OVERALL DIMENSIONS

SPAN 101 FEET 3 INCHES

LENGTH 65 FEET 4 INCHES

HEIGHT 23 FEET 2 INCHES



Three different ground views of the operationally configured F-11A aircraft appear to have been derived from a model in these highly retouched photos. Details in the backgrounds of all three images have also been completely airbrushed out. This was a commonly used technique during World War II, employed by all the major U.S. aircraft manufacturing companies in the interest of not divulging any details of their facilities to the enemy. (National Archives via Dennis R. Jenkins)

Photographic Systems

With a design philosophy quite different from that of the competing Republic XF-12, the Hughes XF-11's onboard photographic equipment was spread out along various components of the airframe, and contained a total of up to 12 cameras. Also, unlike the XF-12, it did not have any photo-developing or film-processing capability onboard the aircraft, either during inflight or static ground operation. A single flight crewmember, designated as the navigator/photographer, had access to the nose photographic compartment only.

Mounted in a small clear nosecone was a single downward-facing vertical Fairchild K-17 camera that could be equipped with various-diameter lenses. Twin oblique cameras with various-diameter lenses were also mounted in the lower nose compartment immediately aft of the clear nose section, facing outboard and shooting through single, clear, fixed-pane windows.

Two downward-facing split vertical Fairchild K-22 cameras with various-diameter lenses were housed in the XF-11's left tail boom aft of the main landing gear well, and the camera windows were covered by two small retractable clamshell doors. These doors operated in a similar fashion to the main landing gear doors. Although production F-11s may have held a combination of split vertical and trimetrogon camera installations, available documentation indicates that there was no provision on the XF-11 prototypes for a trimetrogon camera system. This would normally be comprised of three downward-facing Fairchild K-17B cameras with 6-inch lenses, as used on the Republic XF-12.

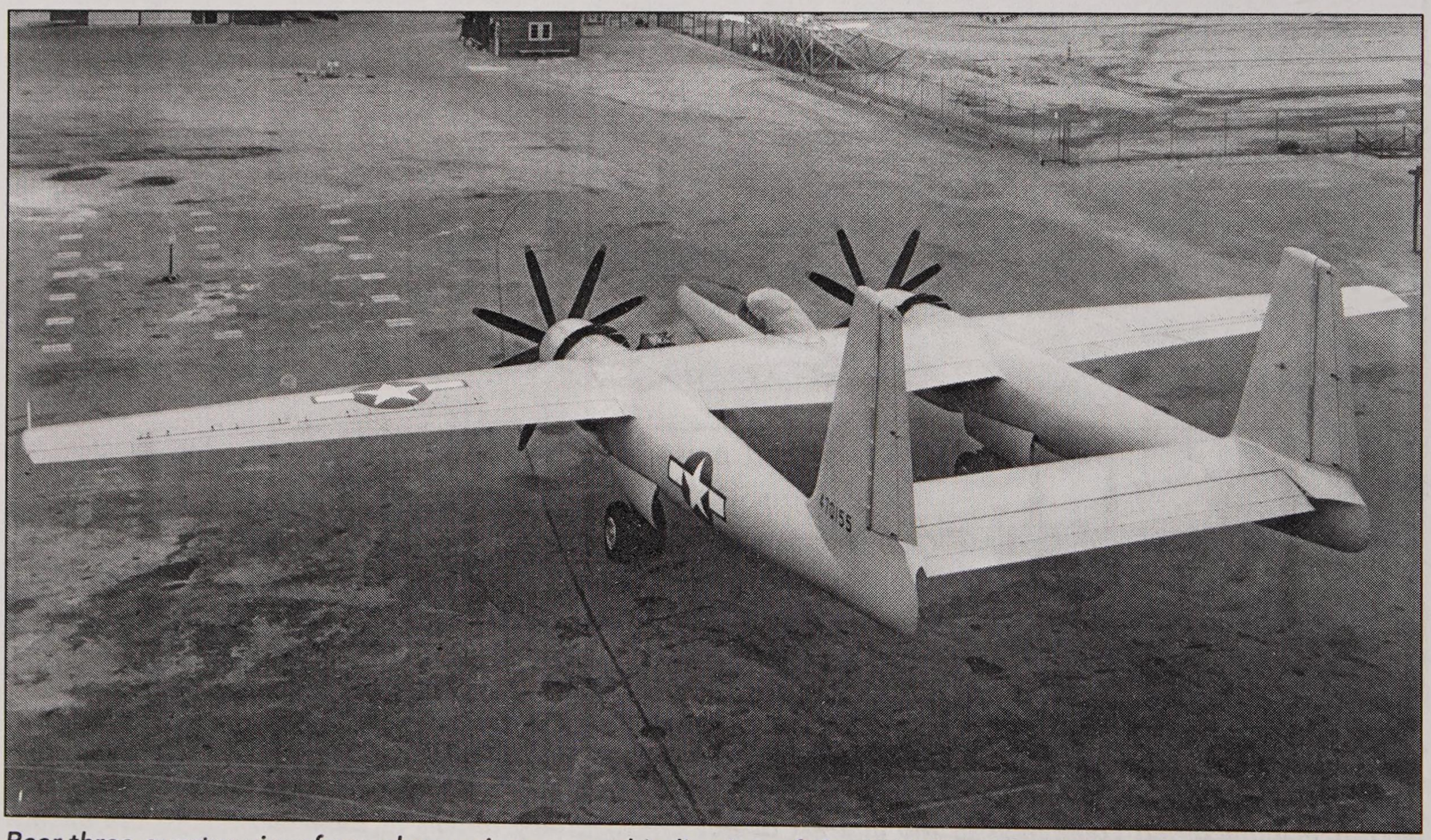
There were no provisions for the XF-11 to carry photo flash bombs for night photography, and inclusion of that capability was found to be problematic by the Army. Specifically, it was determined that redesign of the aircraft's twin tail booms to both accommodate a bomb bay and carry the extra weight would delay potential production. Therefore, it was felt that the XF-11 should be relegated to flying day reconnaissance missions only.

Crew Complement

The XF-11's crew was comprised of an aircraft commander (pilot and commissioned officer) in the forward cockpit and a navigator/photographer (NCO, or non-commissioned officer) in the aft cockpit. An optional crew complement for long-duration missions was comprised of an aircraft commander, navigator/photographer, and an enlisted photographic systems technician who was seated in the aircraft's lower fuselage.

Armament

Although the XF-11 was contracted with no provision for any offensive armament, the aircraft did feature various defensive measures for protection during potential combat situations. Fuel tanks were bulletproof, and were of the self-sealing type, while the cockpit was shielded with 350-pound armor plate. Compared to the larger XR-12, the Hughes airplane handled more like a fighter, defensively.



Rear-three-quarter view from above gives a good indication of the XF-11's unique twin tail boom and fuselage pod configuration. (National Archives via Dennis R. Jenkins)

Howard Hughes—Aviator and Visionary

Eccentric recluse, brilliant visionary, record-breaking aviator, or extravagant billionaire? In the context of this story, Howard Hughes would have to be judged as "all of the above." Seen here, preparing to board the second XF-11 prototype, Hughes presented many positive aspects of aviation to the world in the 1930s and early 1940s. (UNLV Collection via Tony Landis)

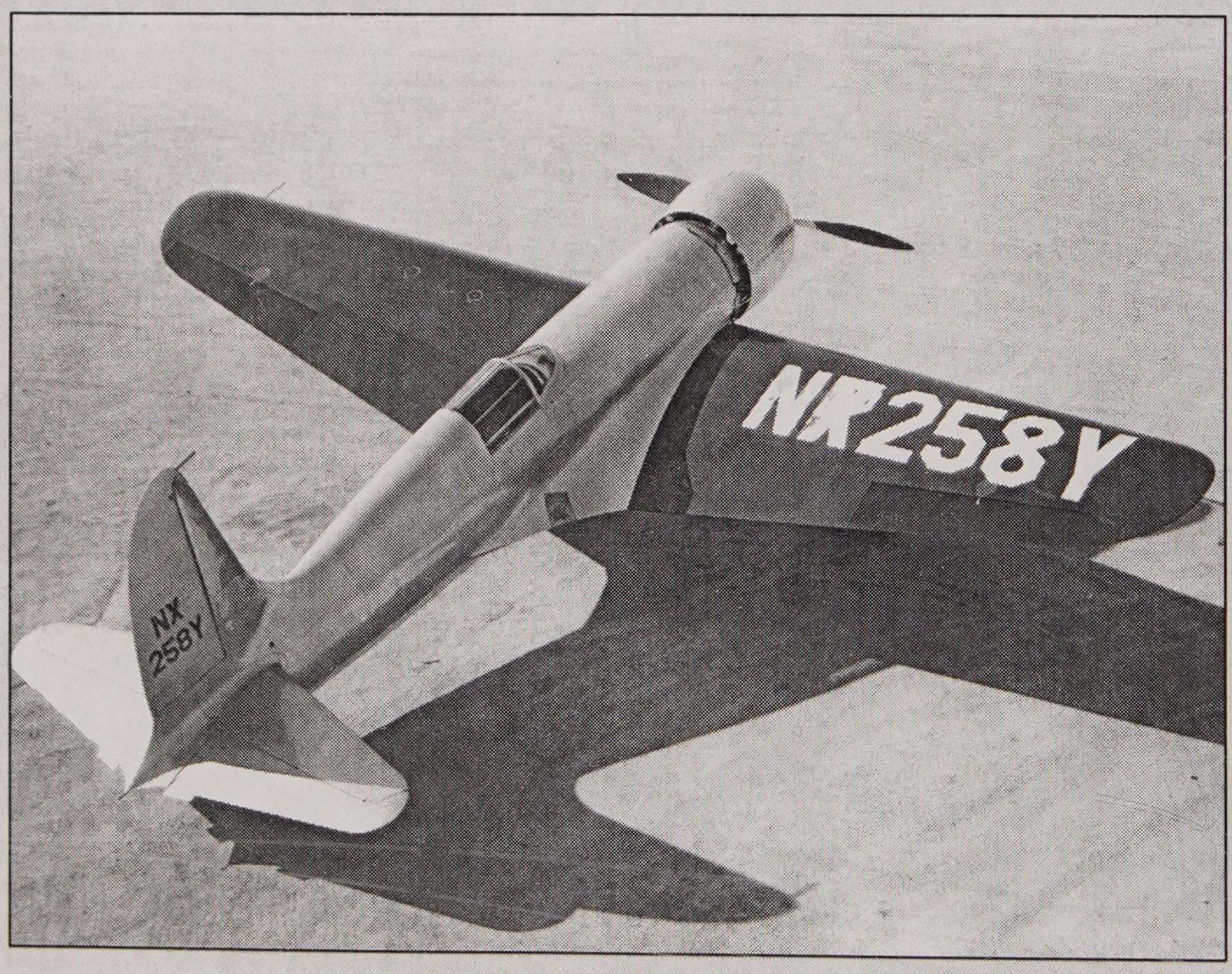
It is no surprise that to the general public, the name Howard Hughes is usually associated with great wealth, eccentricity, reclusiveness, and overall odd behavior, especially toward the end of his life. Seemingly always under public scrutiny for his actions, Hughes constantly sought isolation and solace from the glaring eye of the media and the government, further reinforcing all the mysteries associated with his private persona. To those who appreciate aviation history, however, Howard Hughes, the aviator, is held in a very different regard.

From the early 1930s to the late 1940s, Hughes' aerial accomplishments were most impressive, from setting a 352-mph closed-course world speed record for land planes in his own H-1 racer, to circumnavigating the globe in a Lockheed 14 Super Electra in a record 3 days, 19 hours, 17 minutes. Through these accomplishments, he was thrust into the media spotlight, and soon, numerous transcontinental speed records fell in quick succession to the tall, lanky aviator. Hughes was also the only American to have been twice awarded the Harmon International Trophy for significant achievement in aviation, in 1936 and 1938. He also won the Octave Chanute Award as well as the prestigious Collier Trophy for the advancement of aviation.

The airplane that will forever be regarded as the ultimate symbol of Hughes' aviation prowess, however, is the mammoth eight-engine all-wood HK-1 Hercules flying boat. Better known as the Spruce Goose (even though it wasn't built out of spruce), the HK-1 was the world's largest airplane at the time of its one-and-only flight in November 1947. Conceived in 1942 as an "'aerial troop ship"' able to carry 750 fully armed troops from Honolulu to Tokyo nonstop, or to anywhere on the globe for that matter, the 200-ton Hercules was intended to fly safely above threatening enemy submarines that were torpedoing Allied ships with deadly results at the time. With the exception of engine mounts and other structural metal components, the airplane was built exclusively of laminated birch in order to conserve metals and other valuable materials for the war effort.

Constructed in two cavernous wooden buildings at Hughes' Culver City plant, the massive aircraft's subassemblies had to be trucked 20 miles south to Long Beach where the components were joined together. After a series of high-speed taxi runs, the HK-1 made its one-and-only flight inside the breakwaters of Long Beach Harbor on 2 November 1947. Never flown at an altitude higher than ground effect (measured as the distance of one-half of the aircraft's wingspan), the inaugural hop covered approximately 1 mile in the air with Hughes himself at the controls. With its intended maximum gross takeoff weight of 400,000 pounds and maximum range of nearly 3,000 miles, the HK-1 would have revolutionized military logistics had it entered operational service. However, it was surmised that Hughes flew the giant craft that day mainly to silence the hoards of highly vocal critics who considered the project nothing more than a giant waste of government funds. Once the flight was completed, the airplane was sequestered into a special, hermetically sealed hangar at water's edge for nearly 30 years, never to be seen again until several years after Hughes died in 1976.

Howard Hughes was also instrumental in the creation of Lockheed's classic triple-tail Constellation



The sleek Hughes H-1 Racer was an aeronautical breakthrough when it first flew in 1935, combining such innovations as ultra-smooth flush-riveted external skins, hydraulically retracting landing gear, tight-fitting engine cowling, variable-pitch constant-speed prop, and an engine that ran on 100-octane aviation fuel. Capable of cruising speeds in excess of 350 mph, the Racer—with Hughes in the cockpit, of course—set a world landplane closed-course speed record averaging 352 mph in four consecutive runs at Santa Ana, California, in September 1935. (UNLV Collection via Tony Landis)

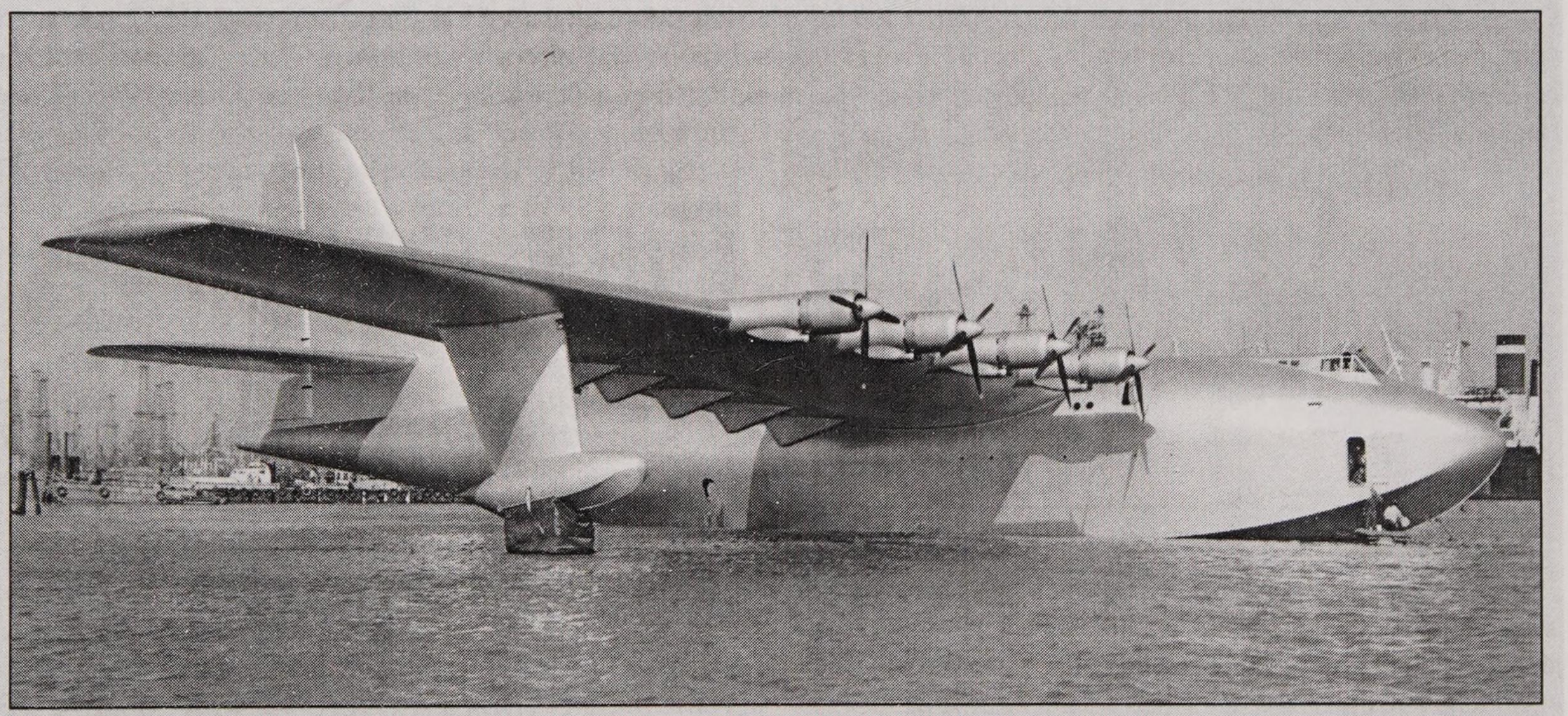
airliner. By taking over ownership of Trans World Airlines in 1940, he served as the guiding hand in transforming TWA from a plebeian U.S. domestic carrier into a world-class commercial airline, setting the industry standard for luxurious intercontinental service from the zenith of the propeller era to the beginning of the jet age. In that regard, Hughes seriously dabbled with the idea of having the world's first turboprop and jet-powered transports to lend TWA both prestige in the industry and a much-needed marketing advantage over rival Pan American World Airways. Both Bristol in Great Britain and Avro in Canada lent their newest aircraft for evaluation by Hughes, but neither the turboprop Britannia nor the turbojet C102 Jetliner was ever purchased for the airline.

Howard Hughes' longest-lasting and perhaps most significant contributions to America's aerospace industry were the Hughes Helicopter Company and Hughes Space & Communications Company. Both were successors to the Hughes Aircraft Company which was founded in 1935 as an offshoot of the Hughes Tool Company. Employing 30,000 people at the Hughes facility in Culver City during the peak years, the company was responsible for the development of the GAR-1 (AIM-4) Falcon, the world's first radar-homing air-to-air missile; the world's first functional laser; and Syncom, the first geosynchronous communications satellite, which was launched in 1963.

Hughes Aircraft Company's 1,300-acre facility in Culver City was of such significant military importance during the Cold War, that it was considered a "Red Star Target" by the Soviet Union, meaning it would be one of the first locations in the United States to be vaporized in a first-strike nuclear attack. Adding the helicopter and electronics divisions plus all the other groups in the company, the entire Hughes organization employed upwards of 80,000 people at the peak of the Cold War during the early 1960s.

Hughes' innovation and leadership in the design and development of space-based communications led to breakthroughs in commercializing satellite broadcasting, such as XM Radio and even DirecTV—capabilities undreamed of in the 1950s and now taken for granted. Hughes Helicopters, which relocated from Culver City to Mesa, Arizona, was sold to McDonnell Douglas in 1984, which in turn, was bought by Boeing in 1997. In 1985, the Hughes Aircraft Company was sold to General Motors, and by the year 2000, Boeing and Raytheon had bought significant portions of the 1.7-million-square-foot Hughes Space & Communications Company complex in El Segundo, California.

Founded and guided by its visionary leader, the Hughes Aircraft Company led the world in the design and manufacturing of small military and commercial helicopters, guided missiles, radar guidance systems, advanced electronics systems, and eventually, modern communications satellites. Many of the ground-breaking products created by this pioneering company have left a proud legacy that is evident around the world to this day.



Mammoth Hughes HK-1 Hercules flying boat at rest at the west end of Long Beach Harbor. The airplane's fuselage length was 219 feet and its wingspan 320 feet—still the longest span of any airplane ever built. The top of this intended troop transport's massive vertical stabilizer was nearly 70 feet above the waterline—the equivalent height of a seven-story building. Note inflatable rubber flotation bumpers strapped to the bottoms of its wing floats in order to maintain a wings-level attitude when the aircraft was at rest in the water. (National Archives via Dennis R. Jenkins)

Chapter Seven

Considering its very short lifespan, any photo of the first Hughes XF-11 is a rare gem. Seen here at the Hughes Culver City plant shortly before its first and last flight in July 1946, XF-11 Ship One (S/N 44-70155) sports its Hamilton-Standard "dual-rotation" propellers that proved to be the aircraft's undoing. Note Douglas A-20 in background that was flown to observe Hughes while he made the one-and-only test flight on 7 July 1946. (Craig Kaston Collection)

Trial by Fire for the XF-11

Although the first Republic and Hughes prototypes both flew from their manufacturer's privately owned airfields, the outcomes could not have been more different. Republic employees celebrated the triumphant inaugural voyage of their new flagship on a crisp winter's day in 1946, while Howard Hughes conducted the XF-11's first flight in relative obscurity the following summer, and nearly perished when his new experimental aircraft developed serious problems in flight, and then crashed into a densely populated residential neighborhood while attempting an emergency landing.

A Different Sort of Flight Test Program

The proud title of "factory test pilot" is reserved for an elite cadre of civilian airmen, often with extensive previous military pilot experience, who put their lives on the line every time they climb into the cockpit of a brand-new aircraft type and fly it for the very first time. In the case of the XF-12, Republic's director of flight operations and chief test pilot, Lowery Brabahm, hand-picked his three-man flight crew, who then trained extensively before putting the big airplane through its paces from the

company airfield in Farmingdale. Hundreds of Republic employees watched in awe as the sleek prototype made not one, but two dazzling low passes over the field on its return from a highly successful 45-minute maiden voyage. It was a day full of pride and accomplishment as dedicated workers saw the fruits of their labor soar in the chilly, cloud-filled winter sky.

Six months later, the competing Hughes XF-11 first took to the clear, sunny, summer skies over Los Angeles, California, but the outcome was decidedly different. With rare exception, Army Air Force regulations stipulated that all first flights of a new experimental prototype aircraft be made from a remote outlying location well away from populated areas. Should the first flight be made from a company airfield, there were very specific rules and procedures dealing with how that inaugural test flight was to be conducted.

In the case of the XF-11, the landing gear was to be left extended throughout the flight to preclude having to deal with gear retraction or extension problems, including any situation possibly serious enough to result in a belly landing. Additionally, a total flight time not to exceed 45 minutes was specified, also to minimize risk in case of mechanical or other systems failure. Finally, all the factors for dealing with possible inflight emergencies were to be carefully reviewed and briefed with the test pilot and chase pilots prior to the first takeoff. These would include detailed procedures for returning to the home airfield; use of specific radio frequencies; and coordination with local air traffic control entities to ensure minimal risk to life and property under the flight path of the airplane, should it experience an emergency.

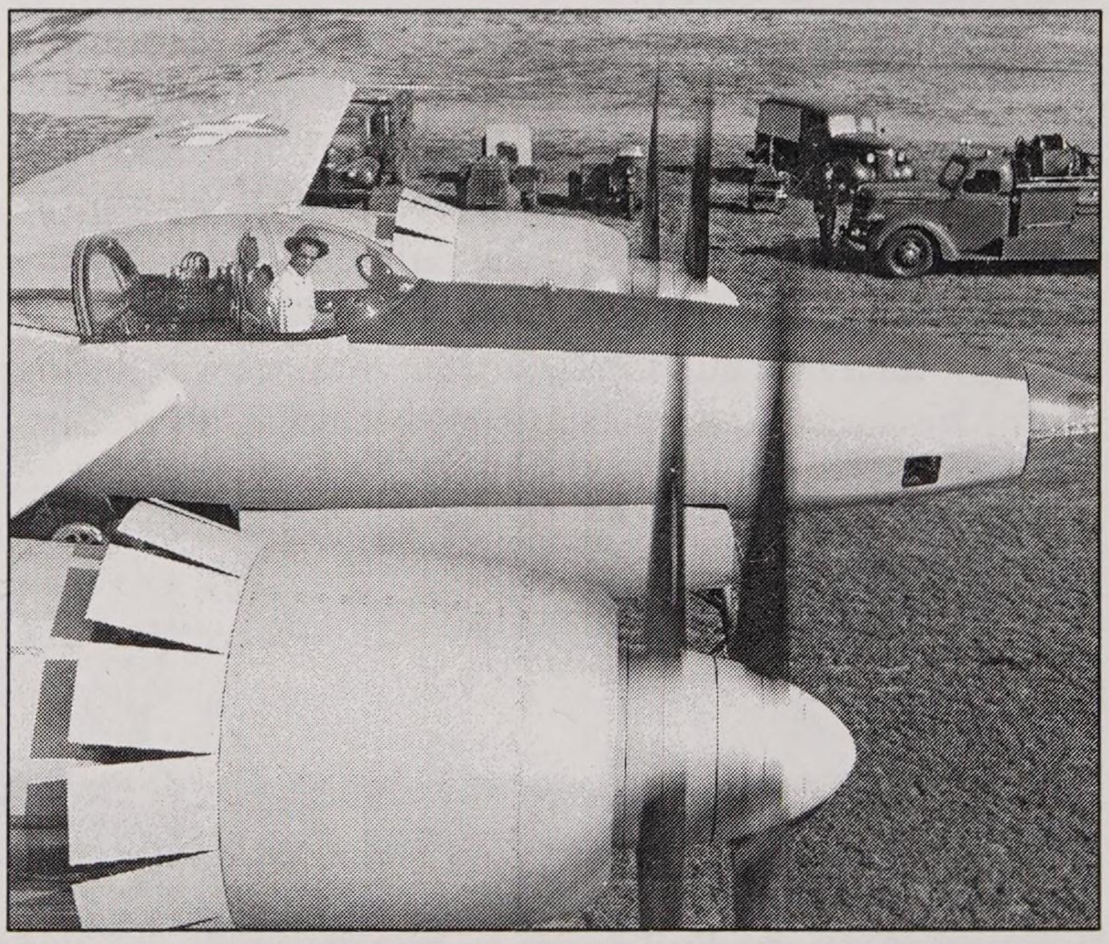
Unlike the Republic crew, or that of any other major aircraft manufacturer in the United States for that matter, the sole test pilot tasked with taking the XF-11 aloft for the first time would be none other than the company's own chief executive officer, Howard R. Hughes himself. The inaugural flight had originally been scheduled for 15 April, but during preliminary taxi tests (with Hughes at the controls), an aborted high-speed run at the company's grass strip at Culver City, California, ended with the airplane blowing a tire during hard braking, and nearly plowing into a small grove of trees adjacent to the runway. A factory tech rep named Frank Prinz from propeller manufacturer Hamilton-Standard was aboard the aircraft that day, and threw the contra-rotating propellers into full-reverse thrust when he realized that Hughes, distracted with reading his flight instruments, was more than likely going to run off the end of the runway.

But there was a "smoking gun" lurking deep in the background of this story, for the oil seals on the complex propeller shafts in the hub of the right-hand engine had developed a slow seepage, and this leak ultimately played a key role in the outcome of Hughes's first flight in the XF-11. After having accumulated additional time becoming more familiar with the airplane and conducting additional high-speed taxi tests that even included brief hops off the ground, Hughes scheduled the next first-flight attempt for Sunday, 7 July.

First and Last Flight of Ship One

Flying back that morning from a weekend of partying with Hollywood celebrities and socialites at the home of Bill Cagney, brother of movie star James Cagney, Hughes was in the company of starlet Jean Peters, World War II hero Audie Murphy, and Cagney himself. He had convinced them to come to Culver City to witness the XF-11's first flight, and even invited Murphy and Cagney to accompany Hughes' chief test engineer and pilot, Glenn Odekirk, to observe the flight in Hughes's personal Douglas A-20 chase airplane.

At about 4:30 that afternoon, Hughes climbed into the fuselage pod of the sleek XF-11 prototype, and strapped himself into the cockpit. Unfortunately, none of his mechanics or engineers was notified of this event, including Frank Prinz. Had he been, perhaps Prinz would have called to Hughes' attention the oil leak in the right-hand-propeller seals, or at least checked the oil levels himself before allowing Hughes to take off. Additionally, and in direct violation of USAAF regulations, Hughes ordered an additional 600 gallons of high-octane avgas loaded aboard to supplement the 600 gallons of fuel originally authorized for the supposed 45-minute flight.



This often-seen, but still very compelling photograph shows Hughes in the cockpit of Ship One ready to taxi. This image is usually captioned as being taken the day of the first flight, and as with the previous photo, lighting conditions indicate that it was indeed taken in the late afternoon. Regardless, seeing Hughes festooned in his fedora and sitting alone in the vastness of the aircraft's cockpit is a chilling image knowing the near-fatal outcome of this flight. (UNLV Collection via Tony Landis)

Company flight test engineer Gene Blandford assisted Hughes with final cockpit checks, but when he asked if Hughes wanted him aboard to assist with flight test duties Blandford was told by Hughes that he would fly alone. It was a decision that undoubtedly saved Blandford's life.

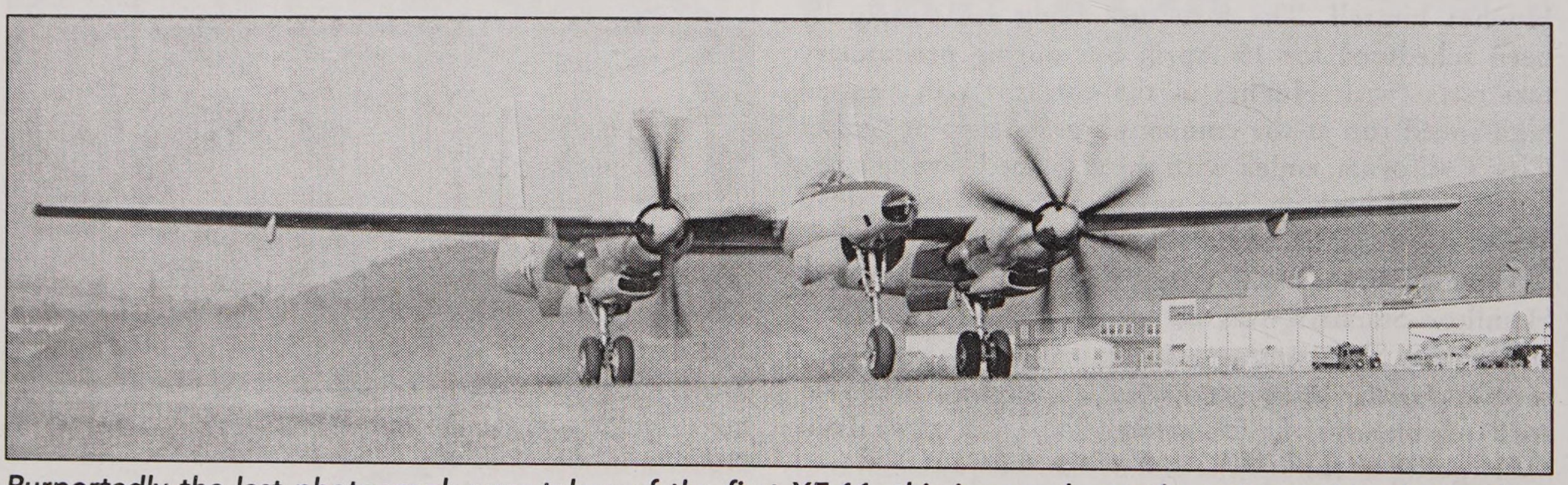
At 5:20 that afternoon, Hughes lifted the 44,400-pound XF-11 into the sky, retracted the landing gear, and headed out over the calm Pacific Ocean west of the airfield. Circling back over the Los Angeles basin, he proceeded to run initial instrument and systems checks while verifying the new prototype's handling characteristics. While circling over Culver City at altitudes between 5,000 and 10,000 feet, Hughes was distracted by an apparent landing gear problem resulting in an errant warning light. He then cycled the gear several times attempting to solve the alleged problem and extinguish the light on the panel. All the while, the A-20 followed well behind and slightly above the XF-11, observing the ongoing inflight activities.

Now several miles east of the airfield and heading in a northerly direction at an altitude of 5,000 feet, disaster struck without warning. Starved for oil that had escaped overboard from the leaking seals, the rear-mounted propeller on the right-hand engine reverted instantly to full-reverse pitch, causing the same aerodynamic effect as if a giant sea anchor had been cast out on the right side of the airplane. The resultant drag caused the XF-11 to yaw severely, and the craft immediately began losing altitude while crabbed to the right.

Complicating matters even further—because the XF-11 was equipped with roll-control spoilers rather than conventional ailerons, as the spoilers deflected with Hughes holding full rudder to counteract the torque from the reversed propeller—the right wing lost a significant amount of lift. As seen from the A-20, the descending right turn seemed to indicate that Hughes was setting up for his initial approach to land back at Culver City, and without radio communication from the XF-11 alerting him to the emergency, Odekirk assumed this to be the case. The A-20 returned to the field with Odekirk fully expecting to see Hughes in the pattern-turning final from a right base leg minutes later.

Back in the XF-11, Hughes was fighting for control of the airplane—and for his life. Suspecting something related to the earlier landing gear problem, he unbuckled his lap belt and shoulder harness in order to peer over the side of the needle-nose fuselage to see if he could view what he thought would be the right main landing gear in the down position, or perhaps even turned sideways to the line of flight. Sinking lower every second and now heading south while descending over the posh residential neighborhoods of Beverly Hills, Hughes realized he would never make it back to Culver City. Looming ahead were the fairways of the Los Angeles Country Club, a site he had once used for a successful emergency landing in a Stearman. A second successful try in the XF-11 was not to be, however. The time was 6:35 pm—1 hour and 15 minutes after Hughes had taken off from his private Culver City airstrip.

Now realizing he had no hope of reaching the golf course either, Hughes braced for the inevitable, and tried in vain to control the errant aircraft as it rapidly settled toward a row of houses on the quiet street below. The resulting crash was swift and violent, and Hughes, unrestrained by his seatbelt and shoulder harness and unprotected by a crash helmet or flying suit, was severely injured in the impact—multiple fractured ribs, a punctured lung, broken nose, multiple lacerations and contusions, and second- to third-degree burns over much of the left side of his body. Hospitalized for more than a month, Hughes was given heavy doses of morphine and then codeine for the excruciating pain of his injuries. (A detailed moment-by-moment breakdown and analysis of the crash is shown in sidebar "Not Quite Par for the Course: The Crash of the XF-11.")



Purportedly the last photograph ever taken of the first XF-11, this image shows the twin-engine photo plane racing down the turf runway at Culver City moments before it lifted into the air and climbed out over the Pacific Ocean. Less than two hours later, it lay in smoldering ruins in a quaint Beverly Hills neighborhood. Since Glenn Odekirk never flew tight formation on the XF-11 and returned to Culver City in the Douglas A-20 chase plane as Hughes began his final descent to the crash sight, there were never any inflight photographs taken of the first prototype. (National Archives via Dennis R. Jenkins)

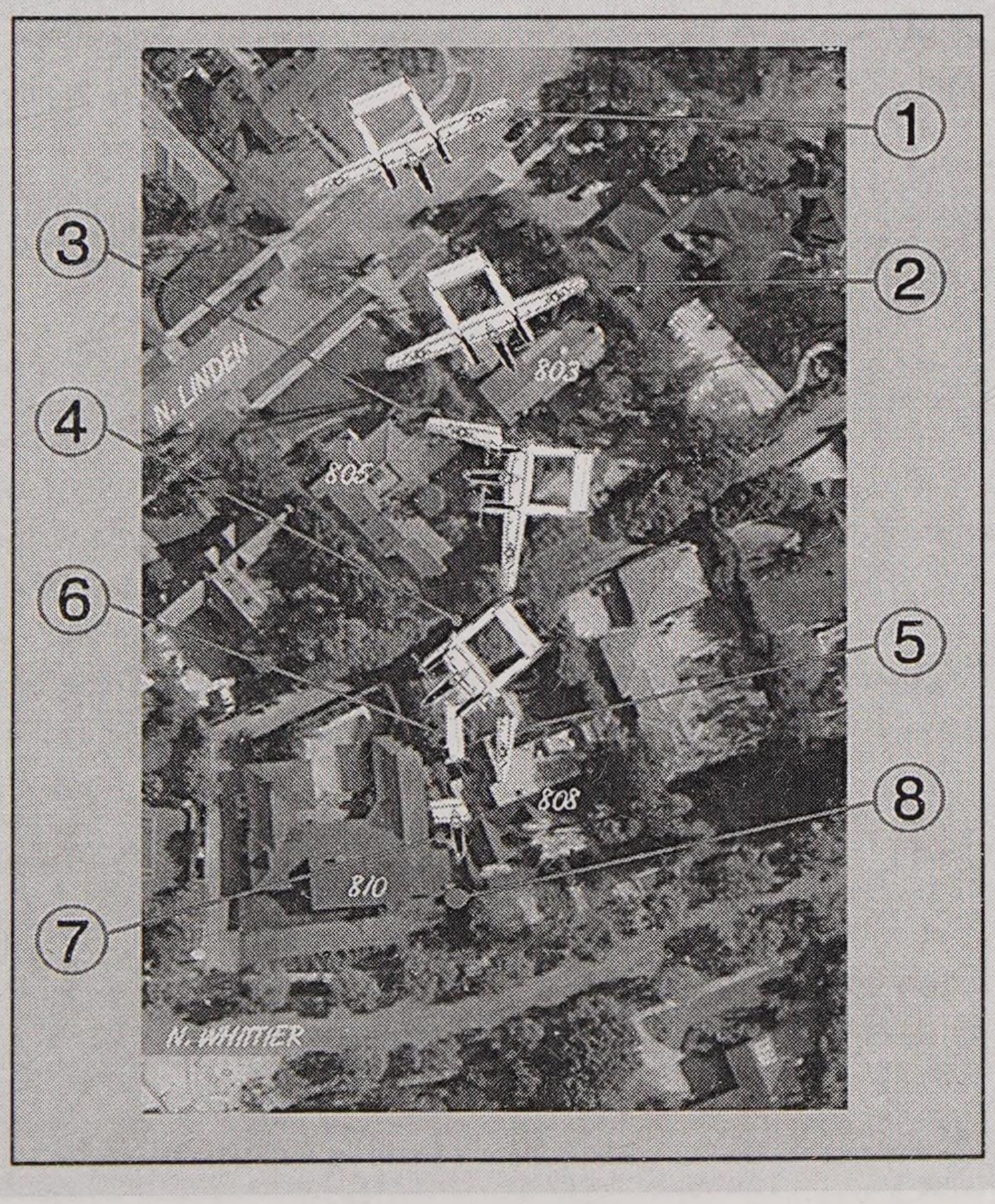
A New Set of Rules

The Army Air Forces Board of Inquiry, established to investigate the accident, found multiple probable causes for the crash, all of which ultimately centered on Hughes' actions as pilot error. Foremost was his disregard for the established rules and regulations that, had they been adhered to, would have eliminated the causal factors of the accident. First, Hughes retracted the landing gear, which led to the problem of his being distracted with the faulty indicator light. Second, he had not established, nor followed, proper procedures for maintaining important radio communication with either ground stations, air traffic control facilities, or his own chase aircraft. Third, Hughes exceeded by half an hour the prescribed maximum flight time of 45 minutes, after which the propeller malfunctioned. Most importantly, by delaying the emergency landing while trying unsuccessfully to identify what went wrong, he did not allow himself enough time to safely return to the Hughes airport or any other suitable landing site within range.

As a result of the Board's findings, all subsequent new experimental prototype military aircraft built at facilities in populated areas had to be either trucked or flown in large cargo transports from their manufacturing plants to safer remote test sites such as the Army Air Forces Flight Test Center at Muroc, California (renamed Edwards Air Force Base in 1949). There they could be flown from the safe expanses of numerous and properly desolate desert lakebeds, without concern for having to deal with civilian air traffic, or causing potential damage to property or anyone on the ground in the event of an inflight emergency.

Miraculously, and against all odds, Hughes recovered from his near-fatal experience with only a few physical scars. As an example of his tenacity and fortitude, he was back in the cockpit of the second XF-11 prototype less than a year after the crash. However, by neglecting to undergo a recommended and proper narcotics withdrawal program upon his discharge from the hospital, Hughes subsequently suffered an addiction to codeine for the rest of his life that, coupled with other business and behavioral problems, relegated him to an existence of ever-increasing reclusiveness. It is unfortunate that for all his many significant accomplishments and accolades in the field of aviation, Howard Hughes—visionary, entrepreneur, and aviator—is more remembered for the strange eccentricities of his later years.

Not Quite Par for the Course:
The Crash of the XF-11



Having waited too long to make a safe emergency landing at either his home field or the nearby Douglas Aircraft facility at Santa Monica Airport, Hughes was committed to finding a suitable landing site amidst densely populated Los Angeles suburbs. As the crippled XF-11 rapidly lost altitude, he attempted an emergency landing on the fairways of the Los Angeles Country Club located just beyond the house at the lower right corner of the photo above. Here is a step-by-step recap of the accident:

1. Realizing he is not going to reach the safe haven of the golf course, Hughes quickly selects a house with a broad flat roof, and attempts to flare the rapidly descending aircraft, hoping to dissipate critical energy in the process. (As famed North American test pilot R. A. "Bob" Hoover always said, "Try to fly the airplane as far into the crash as possible!") The XF-11 narrowly misses the home of Hollywood movie actor Dennis O'Keefe at 802 North Linden Drive. O'Keefe witnesses the entire accident, and then calls the Los Angeles Fire Department.

2. Moment of first impact as the banked right wing drives the landing gear and right engine cowling into the peaked roof of the house at 803 N. Linden Drive, owned by Dr. Jules Zimmerman, a dentist. The left main landing gear then immediately impacts as well. The grazing blow, at a speed of approximately 150 mph, completely demolishes the home's upper story, but slows the XF-11's momentum significantly.
3. As the plummeting aircraft continues flying forward, the right wingtip impacts the house next door at 805 N. Linden Drive, owned by Jerry De Kamp and his wife, Elizabeth, slicing through an upstairs bedroom and slewing the airplane to the right. Now partially torn away from its attach points, the right wing imbeds itself in the roof of the garage adjacent to the house.
4. Skidding sideways completely out of control, the XF-11 impacts and shears off a telephone pole with a large power transformer in the alley behind the homes. This smashes the airplane's canopy, and the fuselage then slams through a fence and into the backyard of 808 Whittier Drive, hurtling toward the occupied home.
5. Sliding left-side-first through the yard, what remains of the airplane drives its fuel-filled left wing into the rear of the two-story structure, igniting a raging inferno that quickly destroys both the house and the airplane. Home owner Lt. Col. Charles A. Meyer was miraculously uninjured, as was his neighbor at 810 Whittier, Gosta B. Guston, a retired Swedish industrialist. Guston's wife, Katherine, lay sleeping in an upstairs bedroom just above the dining room where the XF-11's engine tore through the house.
6. The XF-11's tail section ends its trajectory after what remains of the airplane was thrown violently to the left, leaving only the shattered cockpit section attached to the wreckage of the 101-foot-long wing's center section.
7. The cockpit finally comes to rest between 808 and 810 Whittier Drive now surrounded by fire and the debris of all the trees mowed down in its path. Despite his severe injuries, Hughes manages to extricate himself from the burning aircraft, and crawls out onto what is left of the wing. He is then mercifully rescued from the now-raging fire by Marine Sgt. William Lloyd Durkin, who was stationed at the El Toro Marine Base, but was home on leave visiting friends several houses away. Durkin is assisted by Army Capt. James Guston, son of the residents at 810 Whittier.
8. Having traveled the farthest distance from the initial point of impact, the left engine (with the stubs of its contra-rotating propellers still attached) finally comes to rest in the front yard of the Guston home at 810 Whittier Drive.

Author's Note: Special thanks to Tony Moore and Peter W. Merlin, better known as "The X-Hunters," for their kindly allowing the usage of this information and graphics. Peter and Tony visited this neighborhood in May 2003 to learn more about the historic Hughes crash site. Although these houses still remain, continuous landscaping and area modernization over the years have erased any vestigial traces of the tragedy that happened in the quiet streets of Beverly Hills that fateful Sunday evening in July 1946.

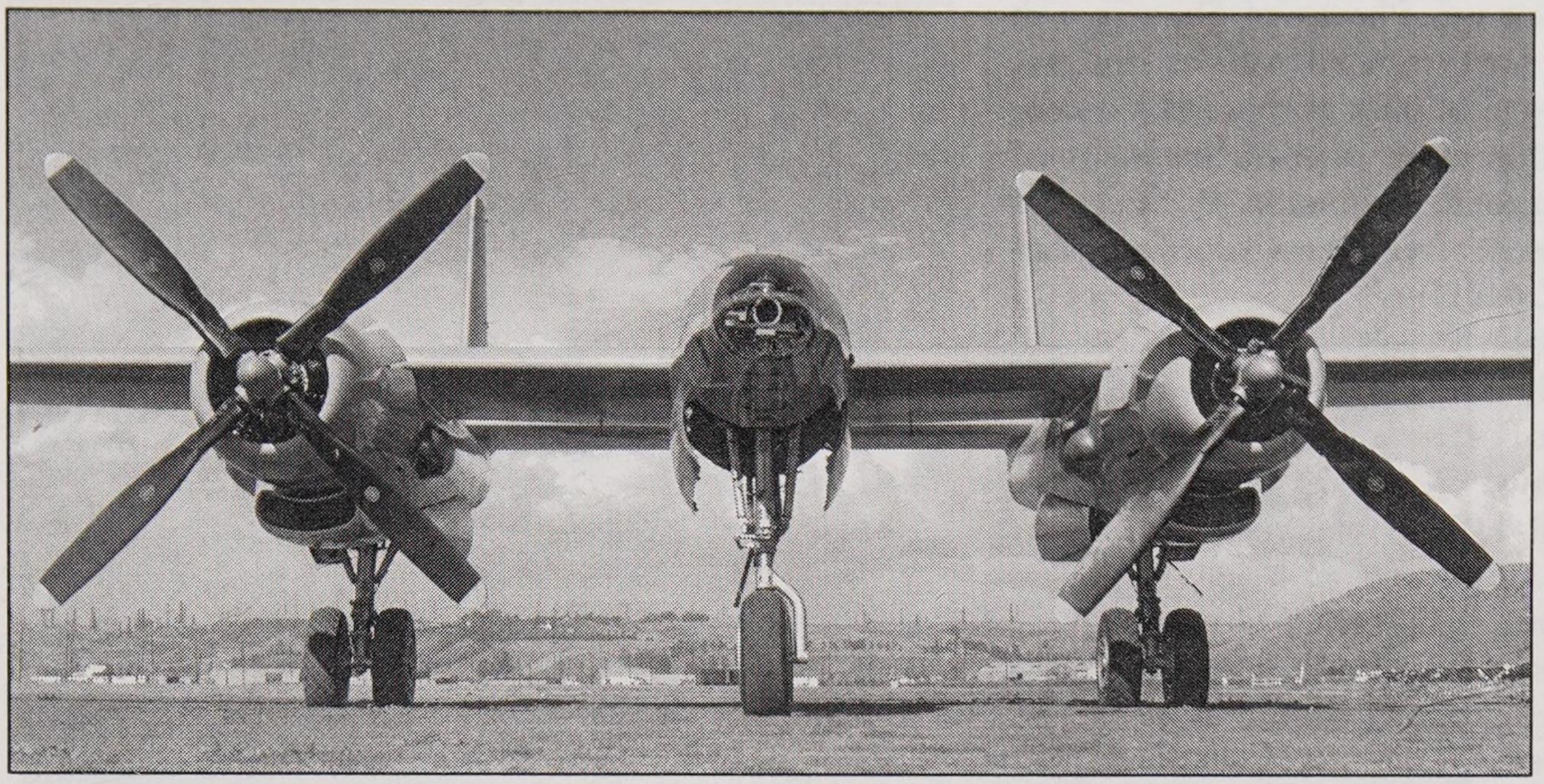
To learn more about this aviation archeology team, please visit www.thexhunters.com. You can also read about the Hughes XF-11 in their excellent book *X-Plane Crashes: Exploring Experimental Rocket Plane and Spycraft Incidents, Accidents, and Crash Sites*, published by Specialty Press (ISBN 978-1-58007-121-5).

The Saga of XF-11 Ship Two

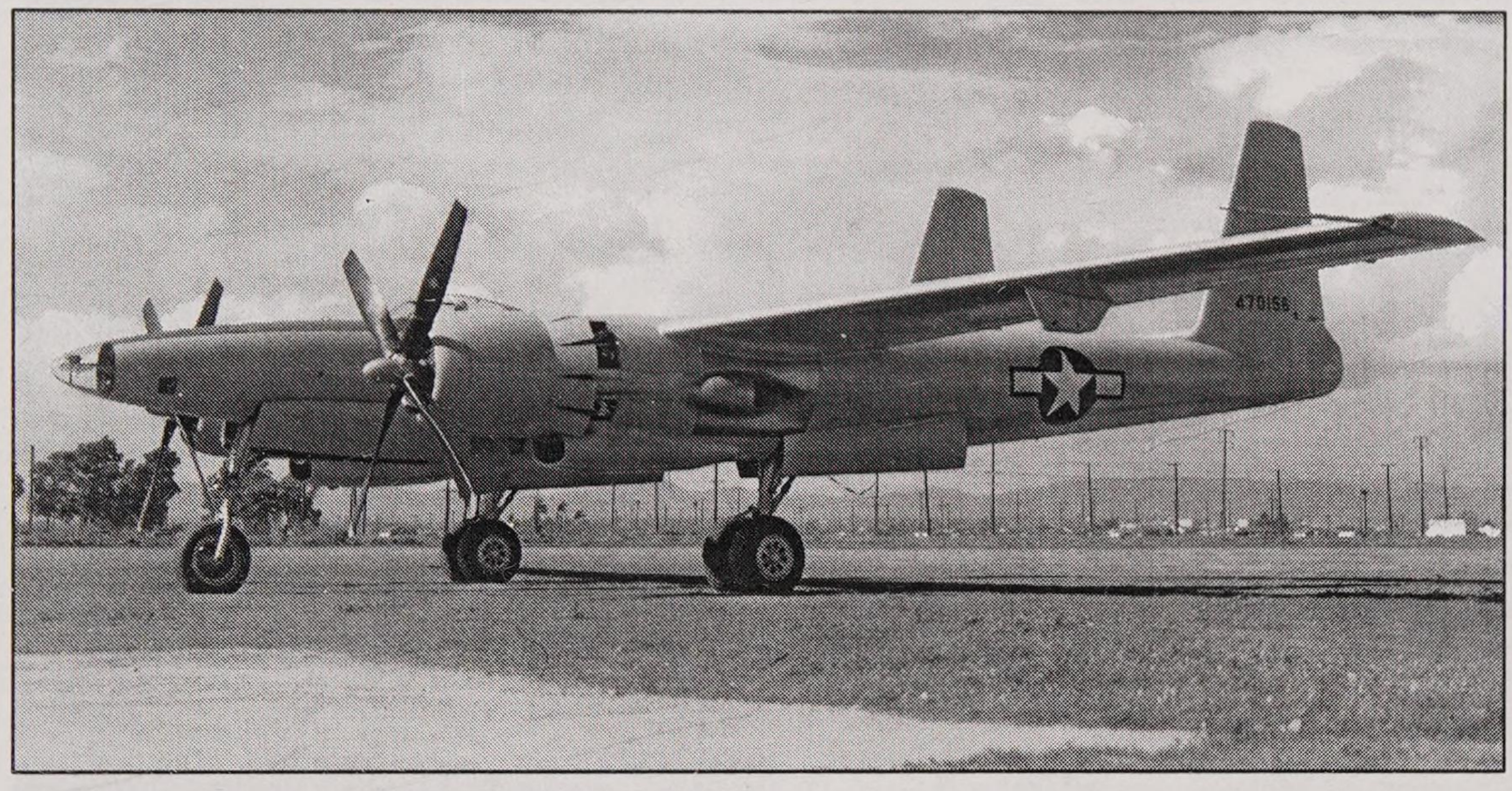
Despite having almost died in the crash of the first XF-11 prototype in July 1946, and despite Army Air Force directives stipulating that the second XF-11 be flown by someone other than Howard Hughes, and from a safe remote location such as the Muroc test center in the Mojave Desert, on 4 April 1947, the second prototype lifted off from the runway at Culver City flown by none other than Howard Hughes. Propelled by single-rotation four-blade Curtiss Electric propellers instead of the Hamilton-Standard contra-rotating propellers that caused the loss of Ship One, XF-11 Ship Two completed its 90-minute inaugural test flight successfully, and re-established some credibility for Hughes's aviation prowess, if not his tenacity.

The Army Air Force was now eager to get its hands on the sole remaining flying prototype, and it was first delivered to Wright Field for Phase I performance testing and then Eglin Air Force Base for a more advanced evaluation of its performance and operational capabilities. While initial reports regarding the aircraft's handling and maneuverability were quite favorable, comments on its operational usage were a bit more reserved. Chief among the complaints was that the camera compartment in the nose was simply too small for comfortable access and that numerous onboard systems were proving to be unreliable in actual use.

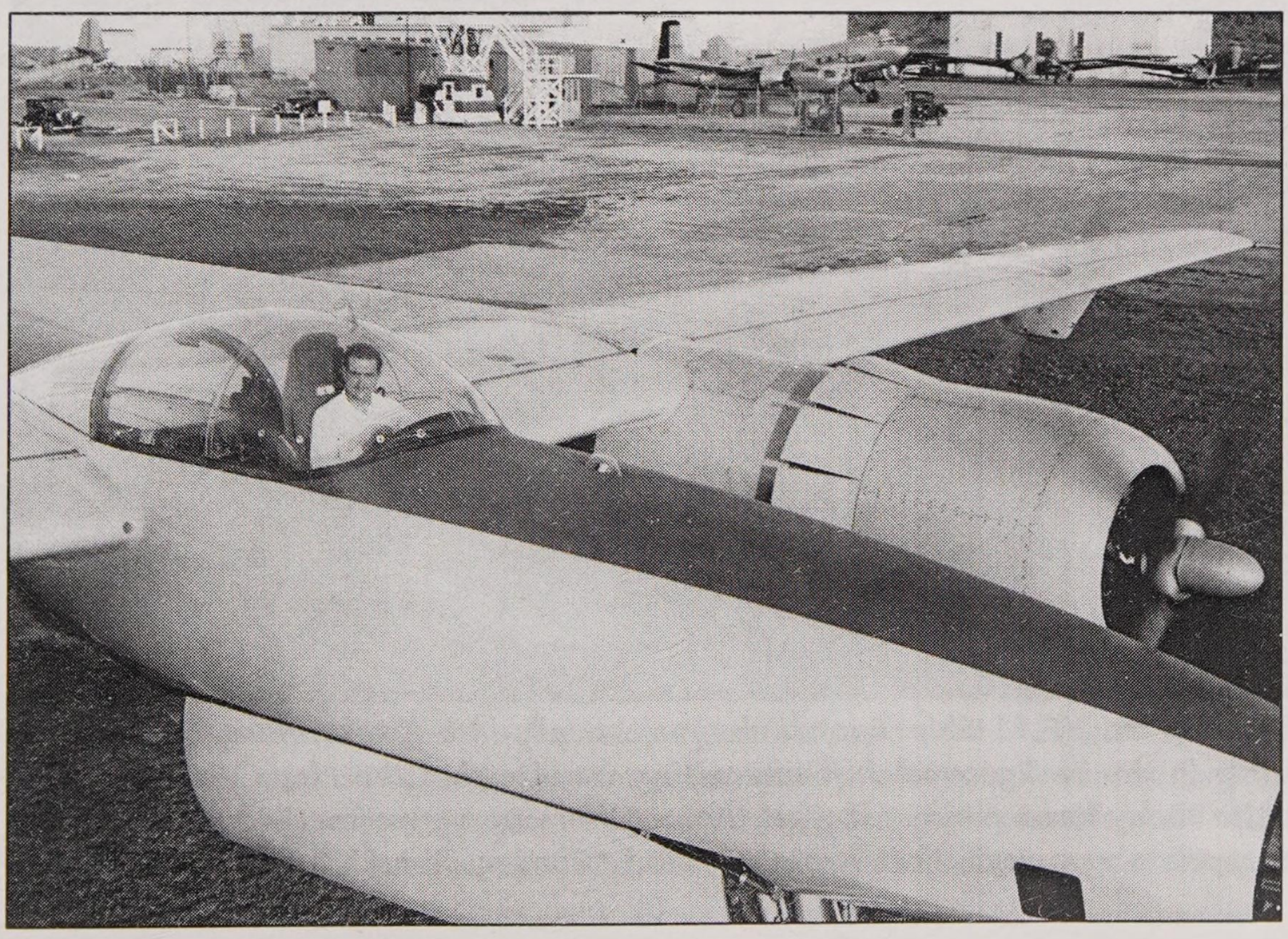
As with the Republic airplane in late 1948, the XF-11 underwent a change to its designation, reflecting the new system created by the Air Force in August of that year. Hence, I refer to the airplane as the Hughes



Dramatic view of the XF-11 leaves no doubt that this is the second prototype, seeing single-rotation propeller blades mounted on the aircraft's twin Pratt & Whitney R-4360 radials. While the contra-rotating propellers on the first XF-11 were built by Hamilton-Standard, the 14-foot 8-inch diameter propellers seen here were Curtiss-Electrics, and were similar to those used on the Northrop P-61 Black Widow night fighter. (UNLV Collection via Tony Landis)



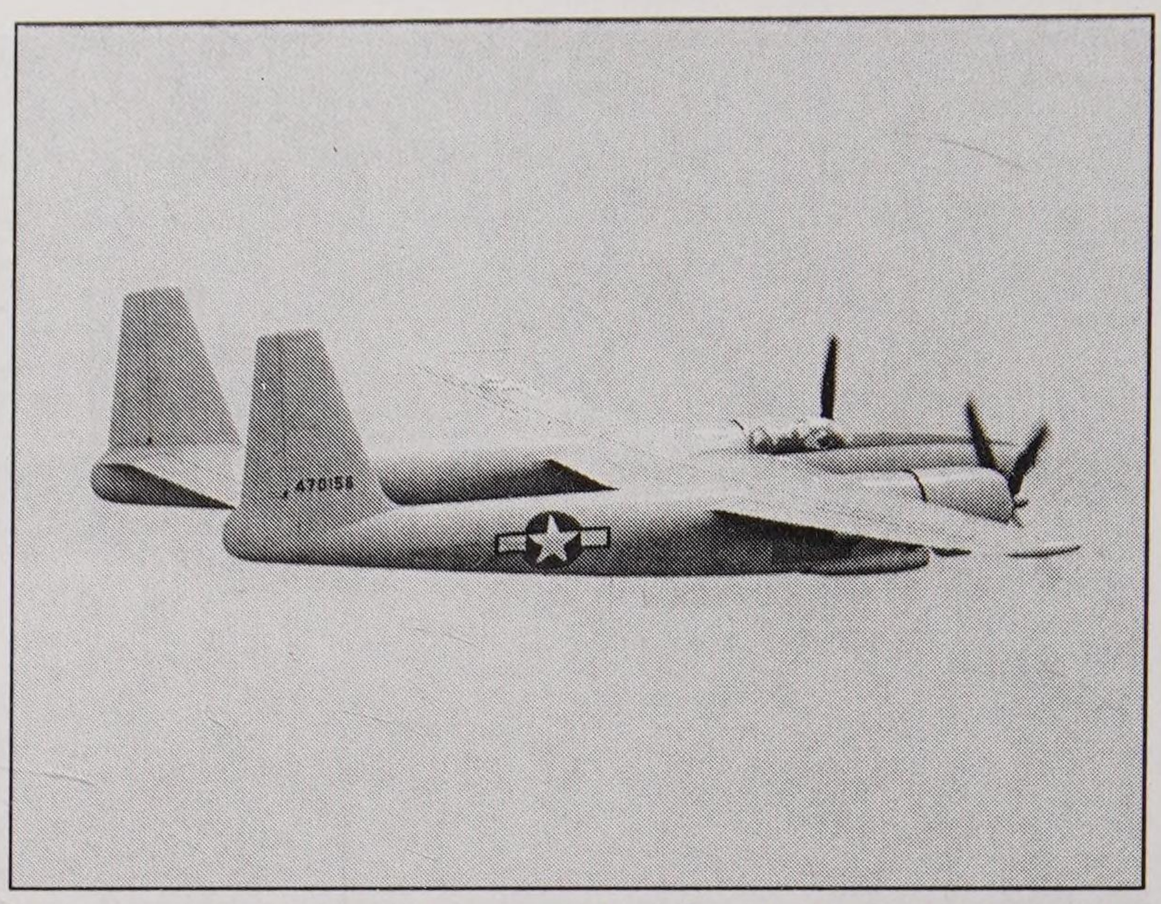
Left three-quarter view of XF-11 Ship Two at Culver City shows the extremely clean external surfaces of the aircraft. Turbo-supercharger exhaust port can be seen directly below the wing and aft of the number one engine. Large build-up of cumulonimbus clouds to the north would indicate that this photo was taken during the summer of 1947. (UNLV Collection via Tony Landis)



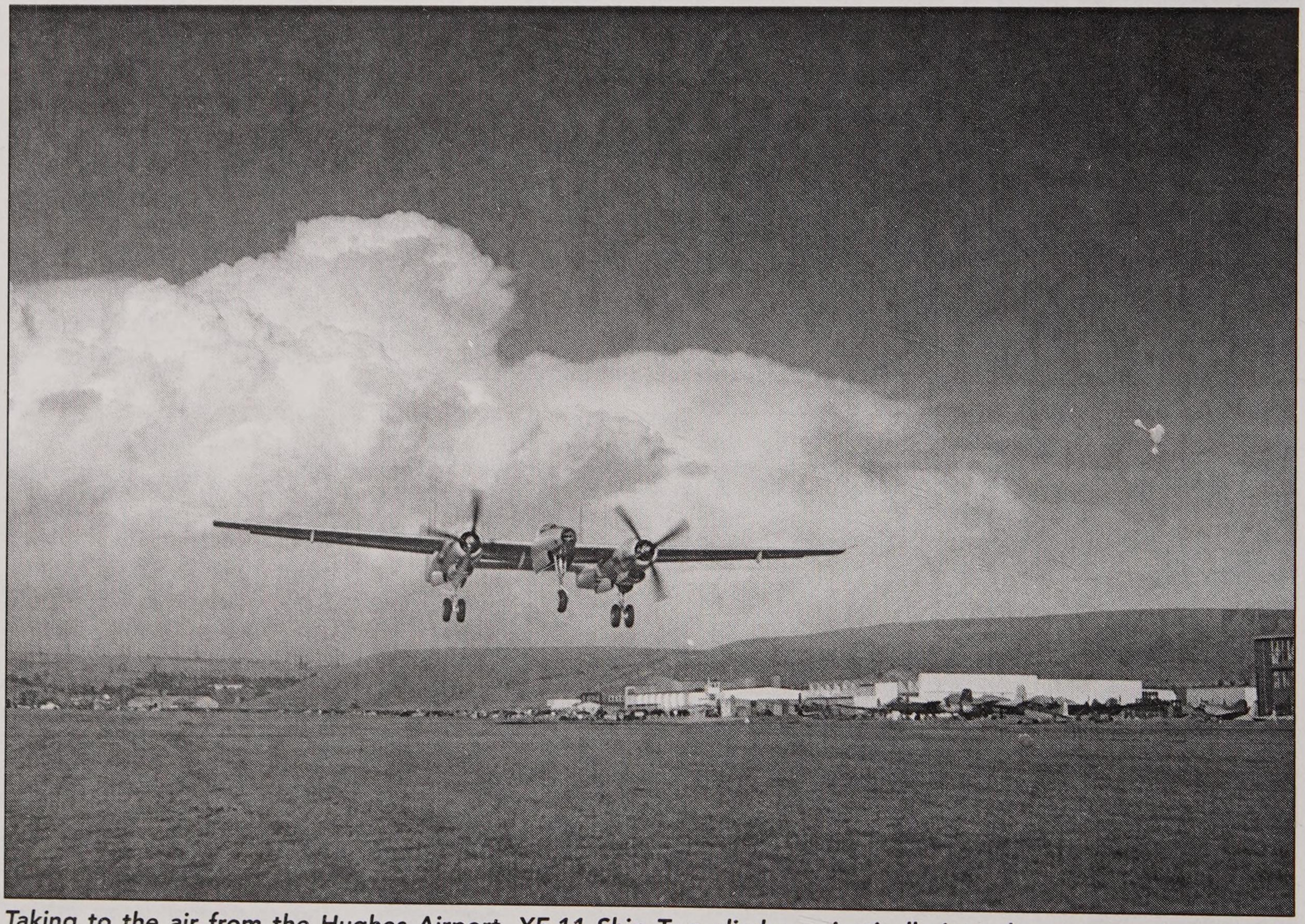
It's déjà vu all over again, as Hughes, minus the Fedora and now wearing a mustache to hide a facial scar from the crash of the first XF-11 nine months earlier, prepares to take off from Hughes Airport in the second prototype on 4 April 1947. Note the wide assortment of Hughes-flown aircraft parked in the background including (from left) a Douglas A-20 Havoc, North American T-6 Texan, Douglas A-26 Invader and C-47 Skytrain, an unidentified test aircraft, Consolidated Vultee BT-13 Vibrator, and Curtiss C-46 Commando. (UNLV Collection via Tony Landis)

"XR-11" from this point on. Photos of Ship Two at Eglin also showed the newly revised national insignia emblazoned on its twin tail booms, with a red bar centered in the white field on either side of the encircled white star. While undergoing evaluation at Eglin Air Force Base, the aircraft was given its own special designation as "Test Item S.T. 64811-4."

In a report filed at Eglin by Air Force test officer and pilot, Capt. Everett R. Meeker, it was stated that "the aircraft's status as to Air Force acceptance has been in doubt ever since its arrival on this station. Late in the reported period, the XR-11 was scheduled for transfer back to the Air Materiel Command [at Wright Field] and its future is still questionable." Further write-ups state, "It is noted that the camera installation in this aircraft is hard to make. Spaces are cramped around cameras, and access to the cameras after installation is virtually impossible." That report continued, "The prescribed number of missions for the test were not flown, as the [air]craft was out of commission most of the time for turbo, engine, or electrical trouble. Approximately 21 hours of flying time was flown at this station."



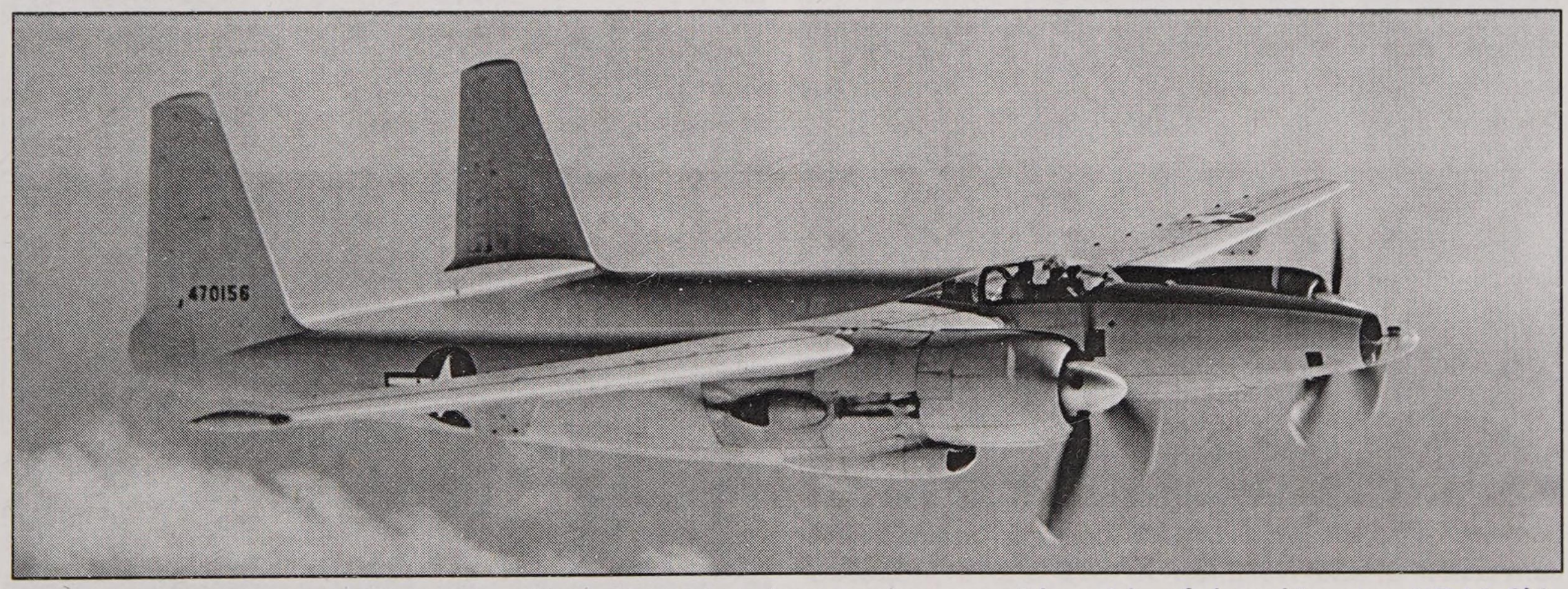
Climbing out over the marshlands of Playa del Rey, the second XF-11 displays its clean lines on the way to another Phase I contractor test flight before the airplane was handed over to the U.S. Army Air Forces' test and evaluation unit at Wright Field in Dayton, Ohio. (UNLV Collection via Tony Landis)



Taking to the air from the Hughes Airport, XF-11 Ship Two climbs majestically into the summer sky with the Hughes manufacturing facility visible in the background. It is interesting to note that the Playa Vista development complex that occupies this site today has a main east-west thoroughfare running directly over where the turf runway is pictured here. Appropriately enough, that street is called "Runway Road." (UNLV Collection via Tony Landis)

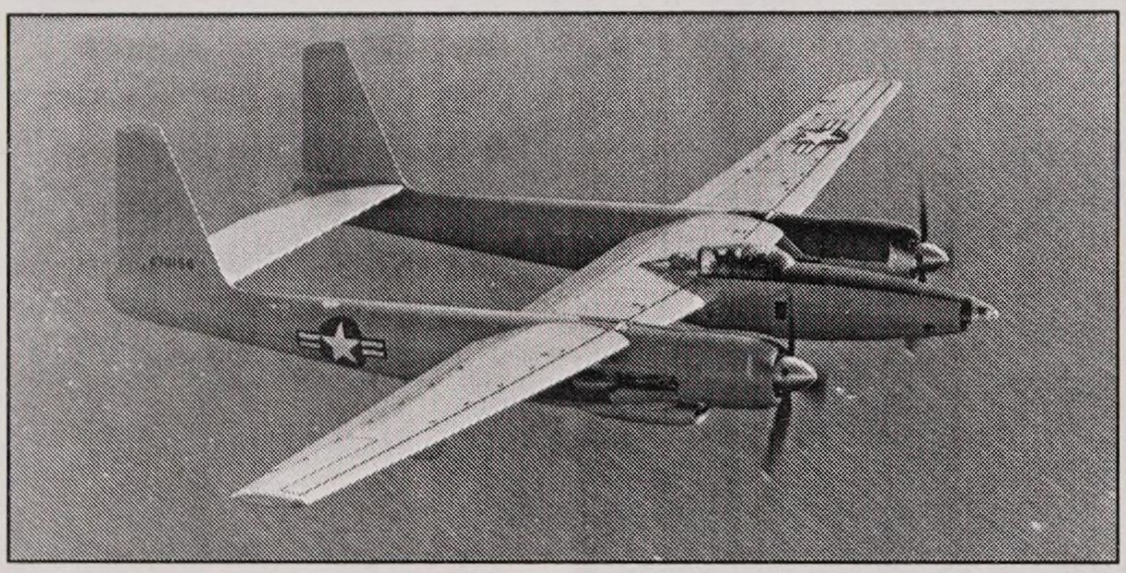
Although the surviving XR-11 did not suffer the same ignominious fate as the surviving Republic XR-12 or swing-wing Grumman XF10F Jaguar by being blown up as a ground target on an ordnance range, it did languish outdoors in the hot dusty Texas weather at Sheppard Air Force Base in Wichita Falls, where it had been delivered in November 1948 after being struck from the Air Force inventory. There, it served as a ground mule for various Air Force technical training schools located on base, but reports indicated that, in yet another blow to future aviation museum collections, the unused static-display aircraft became derelict from non-use, and was scrapped on site.

With Hughes factory photographers and the press at the ready, Ship Two prepares for its first flight from Culver City. Unlike in today's 24-hour media news cycle, such events were filmed and presented in what were called "newsreels" shown before feature-length movies in theatres across the country. First flights of any new type of aircraft were considered as exciting and newsworthy in the days before television. Note crowd of spectators outside the airport fence at Jefferson and Centinela Boulevards just north of the plant. (UNLV Collection via Tony Landis)

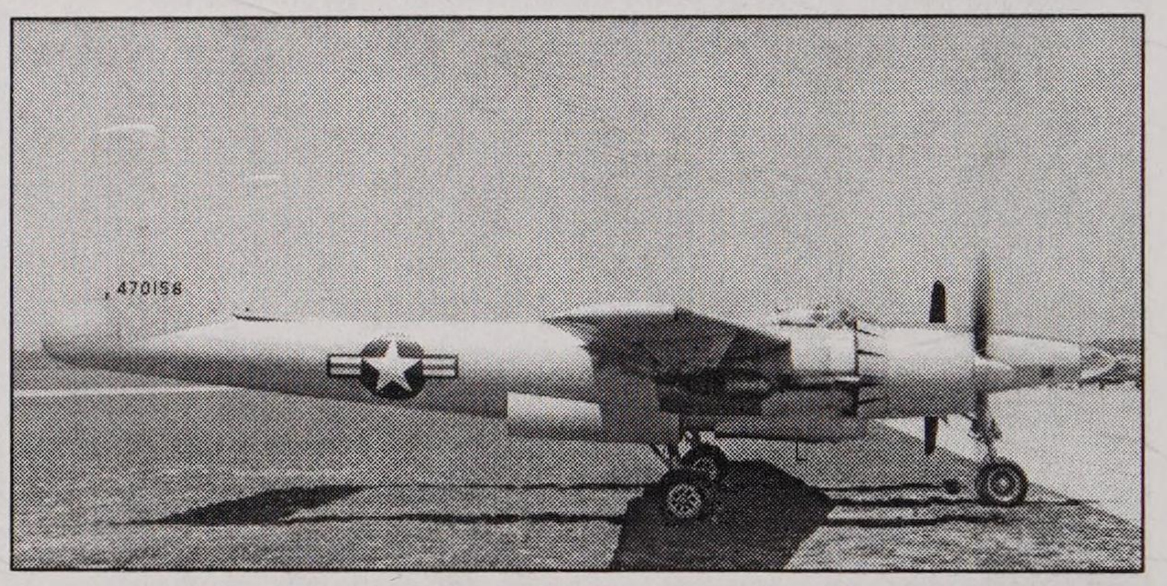


Now wearing the post-1947 national insignia with red center bars on either side of the white star, XF-11 Ship Two cruises above the clouds. Markings for both prototypes included large national insignia on the outboard side of each tail boom and upper left and lower right wings, plus black 24-inch-high registration numbers on the outboard surfaces of each vertical stabilizer. Neither aircraft ever wore "U.S. AIR FORCE" lettering anywhere on their airframes. (Craig Kaston Collection)

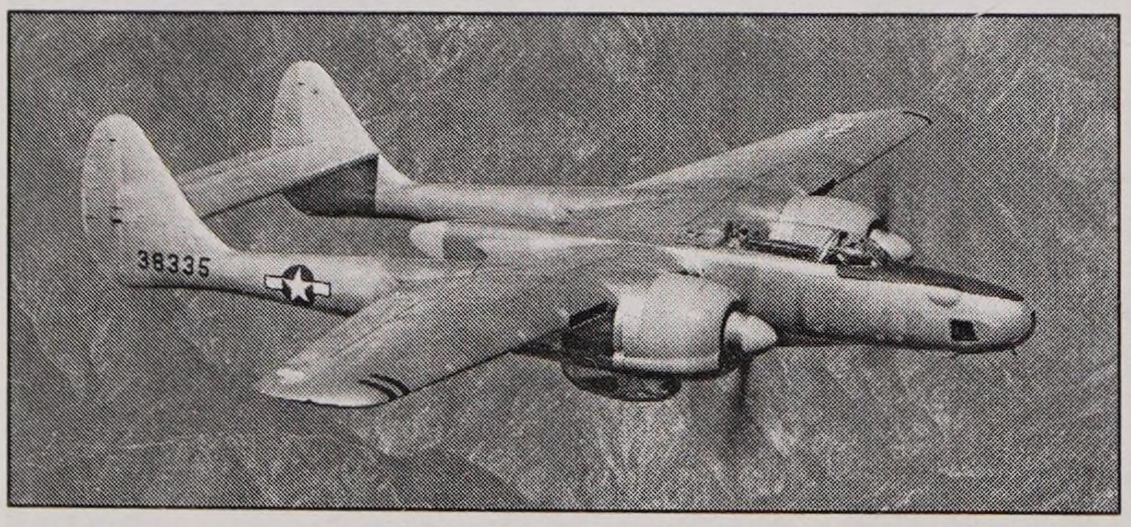
Unusual view from the chase plane reveals the distinctive shape of the Hughes XF-11. Although both prototypes were fitted with pylons underneath the outer wing panels, there are no known photographs of the aircraft actually carrying external auxiliary fuel tanks on those hardpoints. (National Archives via Dennis R. Jenkins)



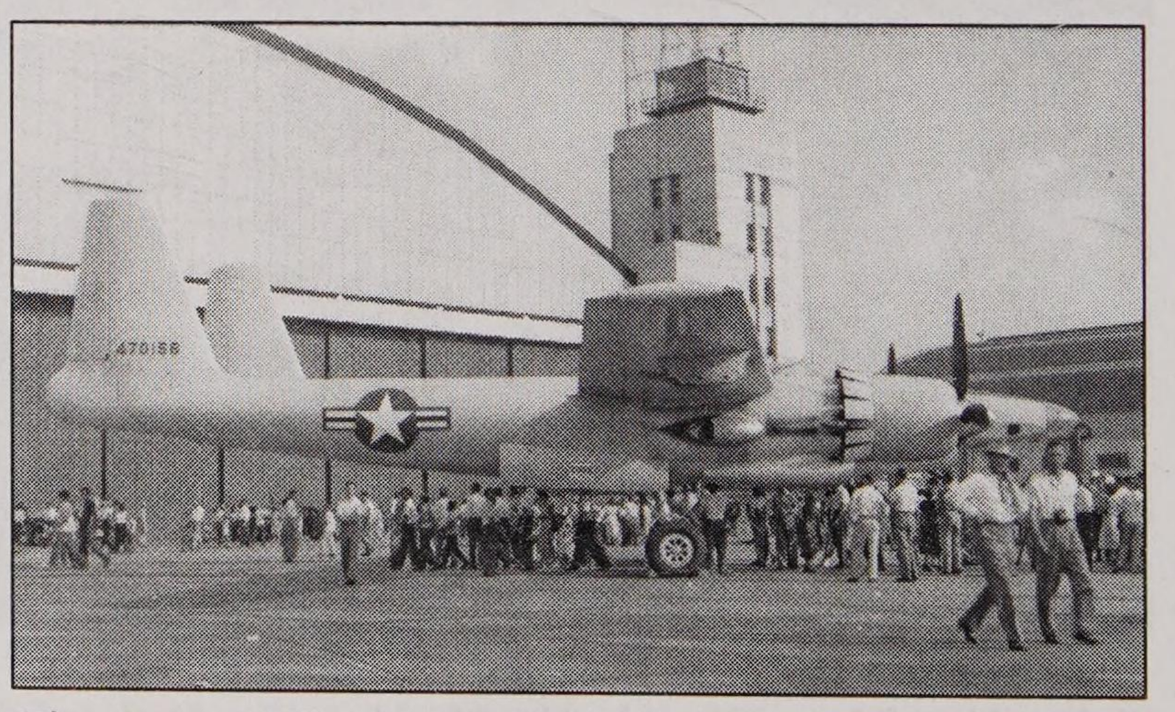
The second Hughes XF-11 flies over the Channel Islands of Southern California as it prepares to descend into the Los Angeles area after a test flight over the Pacific on 20 July 1948. (National Archives via Dennis R. Jenkins)



XF-11 Ship Two taxies out for a test flight at Wright Field in summer 1948. Aircraft's significant height above the ground is evident here when looking at the diminutive size of the pilot in the cockpit. (National Archives via Dennis R. Jenkins)

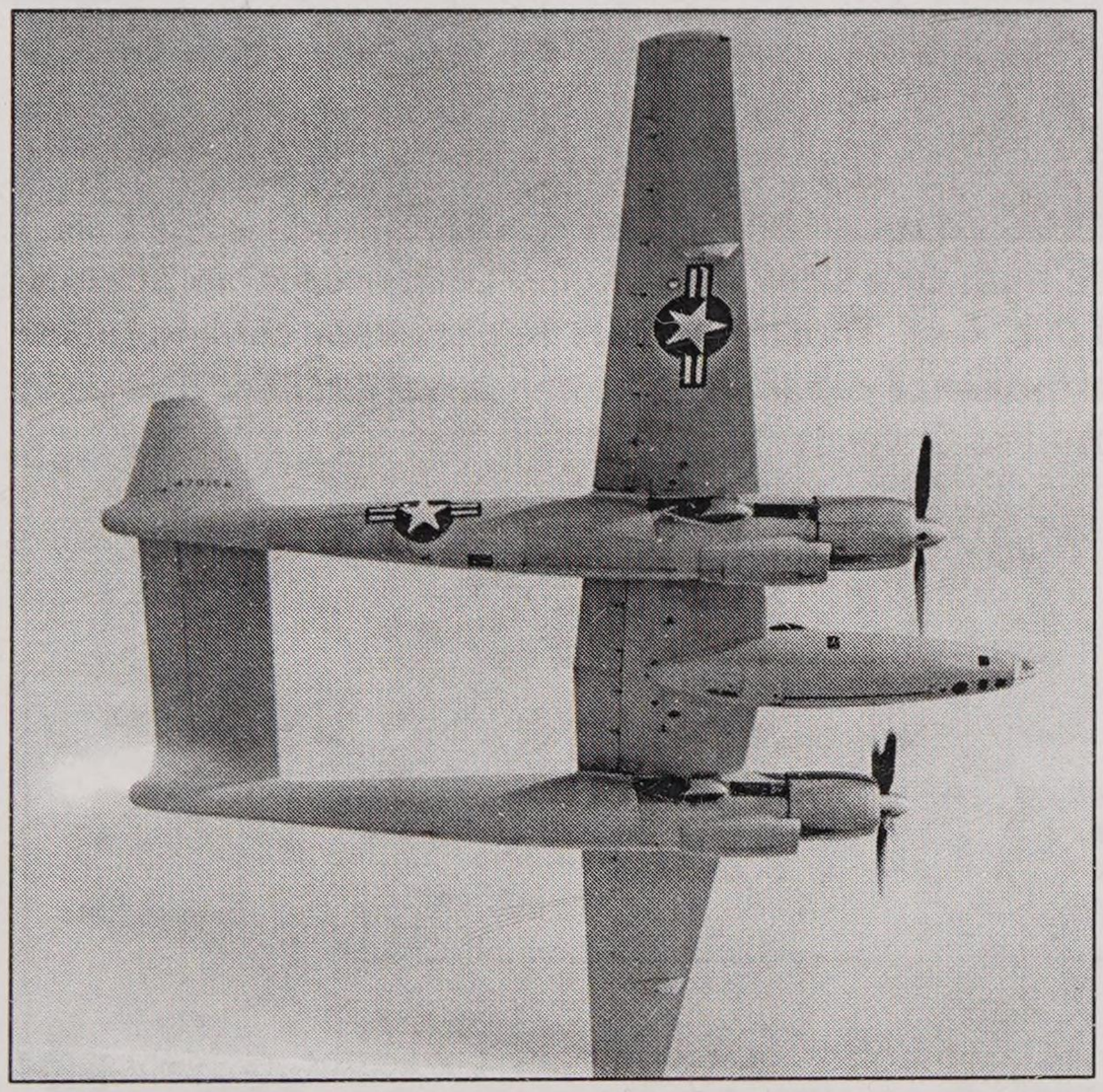


Looking quite similar to the XF-11 is this one-of-a-kind conversion of the Northrop XP-61E into a proposed photo-recon variant designated as the F-15 Reporter. Powered by Pratt & Whitney R-2800s, as was the Hughes DX-2, this Northrop airplane befell the same fate as the XF-11, having been canceled in 1947. (Wings & Airpower Historical Archives via Author Collection)

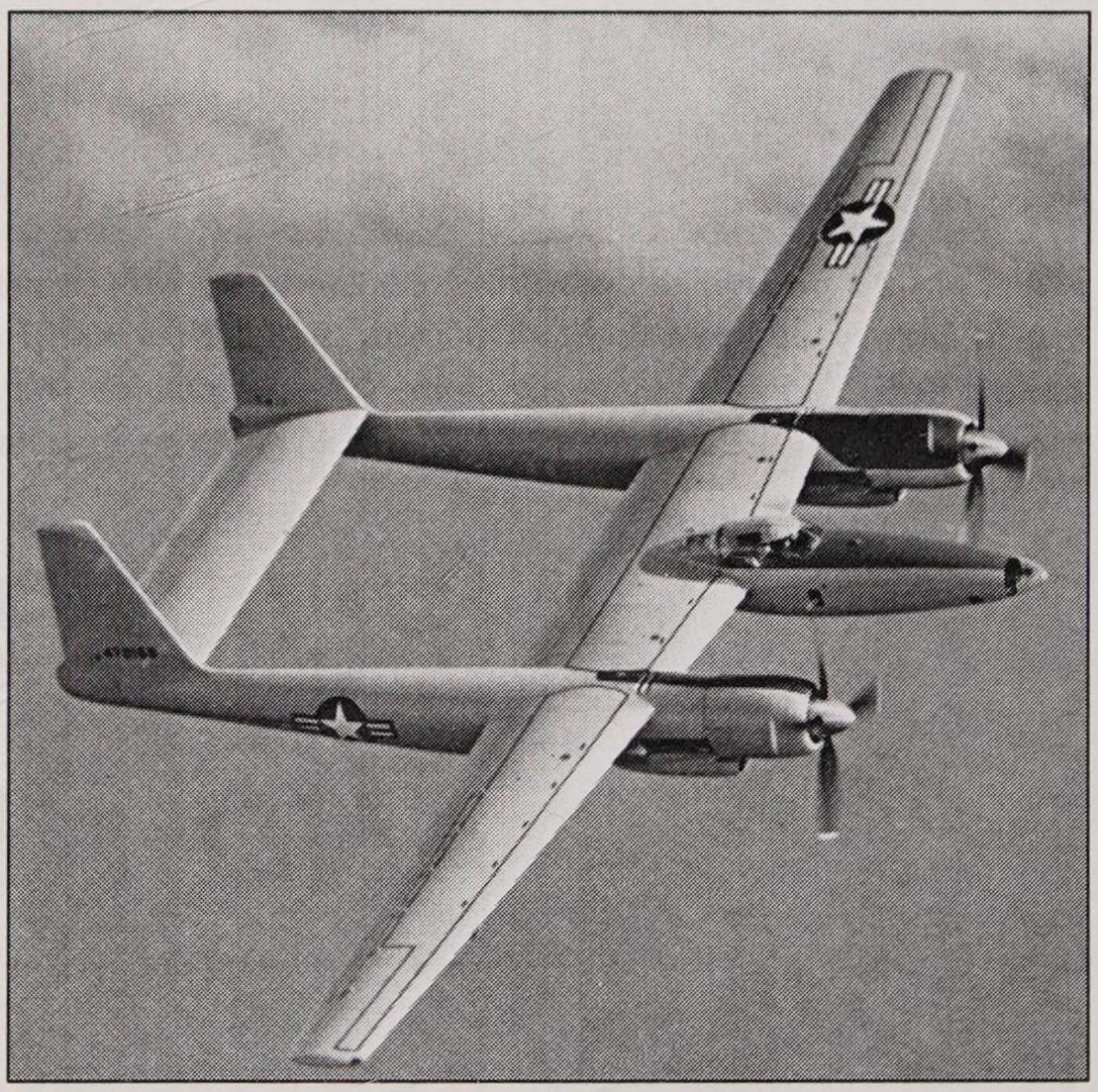


The second XF-11 is parked on static display at Wright Field in September 1948. Note large "NO SMOKING" sign taped to the aircraft's right outer main gear door. (National Archives via Dennis R. Jenkins)

Rare candid photo of the second XF-11 prototype at Selfridge Air Force Base, Michigan, taken on 10 June 1948 during an open house for the American Ordnance Association. Photo shows the small bomb-bay-type doors for the left-hand tail boom camera housing in the open position, seen immediately aft of the left main landing gear wheel well. (Ed Crawford)

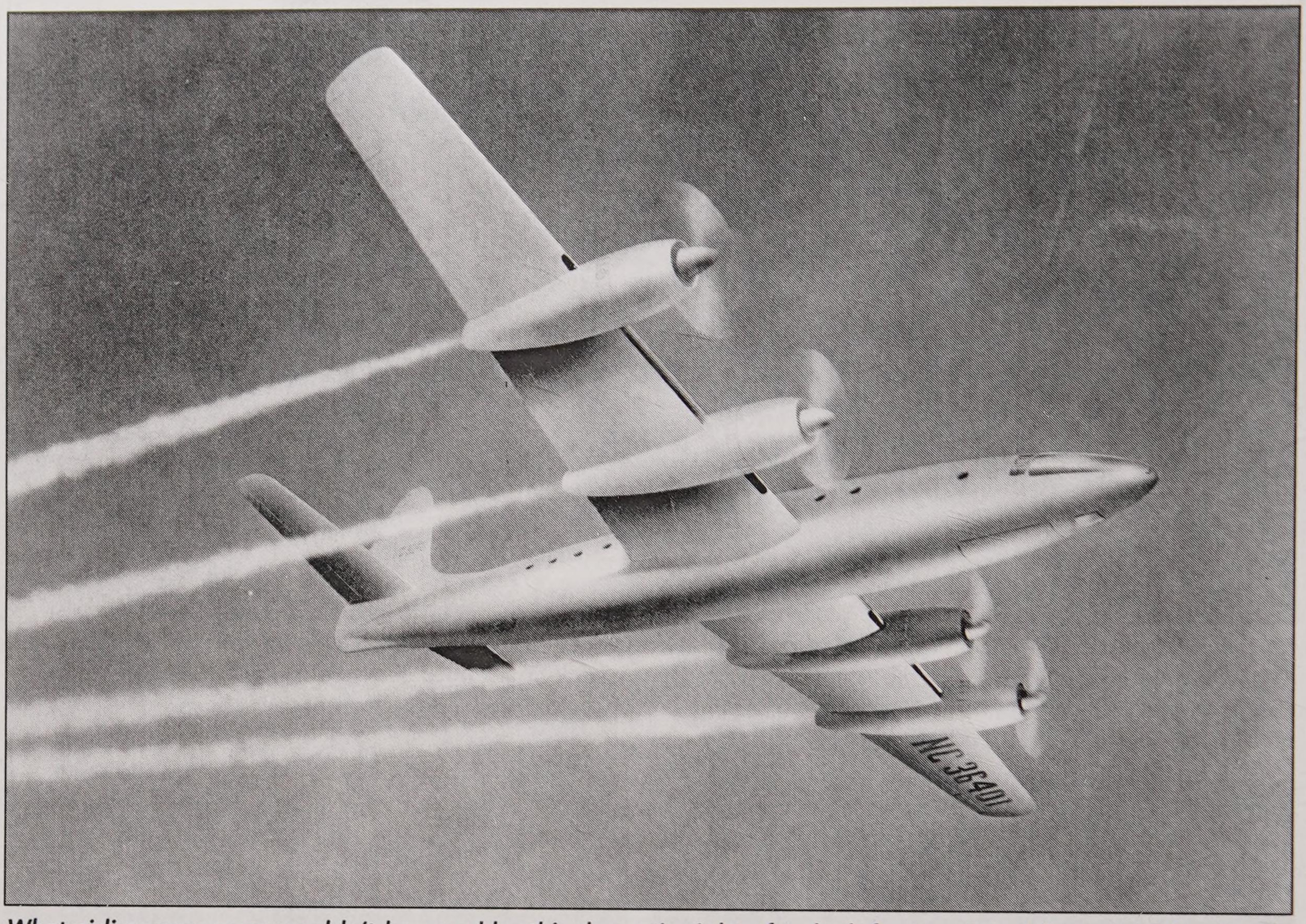


Peeling away from the camera plane, XF-11 Ship Two presents a highly arresting aerodynamic shape, indicative of Hughes's advanced design philosophy for a high-performance twin-engine photo-recon aircraft. Note wide variety of camera window shapes visible under the nose and fuselage pod. Camera gear housed in the left tail boom was fully enclosed inside retracting clamshell doors located immediately aft of the main landing gear well. (National Archives via Dennis R. Jenkins)



Banking toward the camera plane, Ship Two displays its nearly 1,000 square feet of wing area to best advantage. Wingspan of the XF-11 was 101 feet 4 inches. (National Archives via Dennis R. Jenkins)

Chapter Eight



What airline passenger wouldn't be awed by this dramatic sight of a sleek four-engine airliner capable of cruising in luxury at speeds of 400 mph and altitudes of 40,000 feet. Those numbers might seem commonplace today, but in 1946 they represented literally twice the performance capability of commercial airliners that year, most of which were converted World War II transports. (Author Collection)

Airliner Dreams and Realities

In 1948, the ultimate commercial airliner would have been an airplane faster than the Boeing Stratocruiser, sleeker than the Lockheed Constellation, and with twice as much range as either one of them. The XR-12 would have been that airplane, had it been built as an airliner, and that was precisely what Republic hoped to accomplish. Formally designated as the RC-2 for "Republic Commercial," this aircraft was to be symbolically named for the tranquil peacetime calm enveloping the world after five turbulent years of war. Since Republic's P-47 best symbolized the company's wartime role with the name "Thunderbolt," this new airliner could only be called one name: the "Rainbow."

With 250-mph cruise speeds generally the norm for piston-powered airliners in 1948, the Rainbow would have offered near-jet-like performance for the growing number of post–World War II airlines. The world's airline passengers were flying in excess of 50 million miles annually that year, and Republic's intense desire to diversify its product line now rested squarely on the success of

the RC-2. While initial orders from American and Pan Am lent some badly needed prestige and momentum to the program, the cold reality of post-war economics was coming into focus, and Republic's hopes for building a commercial airliner began to waver. With the cancellation of the XR-12's military production contract, those hopes were swiftly and inequivocally dashed.

Luxury at 40,000 Feet

"Named the Rainbow, a new 400-mph-plus transport, slated to carry 40 passengers, is now under development by Republic Aviation at Farmingdale, L. I., N.Y. One of the craft's features will be browsers, which, fitted to each of the four P&W Wasp Major R-4360 engines, are to add a total of 800 [hp] through jet action. . . . A luxurious noise-proof pressure cabin has been planned for long distance traveling at high altitudes. It is to contain complete dining facilities, a lounge, a bar, place to store wraparounds, motion picture facilities, and fluorescent lighting."

Sounding like the description of modern intercontinental jetliners today with their digital entertainment systems, inflight phones, and even Wi-Fi, this quote was actually taken from an article in the October 1945 issue of *AVIATION* magazine. The promise of such futuristic features on a passenger aircraft must have been perceived as being almost science fiction back in 1945, especially considering that this magazine was on the newsstand a mere two months after the Japanese surrender.

Possessing the same basic airframe as the XR-12, the RC-2 incorporated a 5-foot fuselage stretch immediately forward of the wing. Despite the seemingly major commonality with the XR-12, the RC-2 was in reality almost a completely different airplane. The fuselage interior was totally different, with the XR-12's spacious cabin and three camera stations giving way to a comfortable, but more intimate, 40-seat passenger configuration. The military aircraft's lower fuselage also had to be completely redesigned to accommodate multiple baggage and cargo bays. Fuel capacity was increased, and many of the onboard systems were completely different, with the XR-12's avionics racks being replaced with much more plush accommodations for the luxury passenger-carrying market.

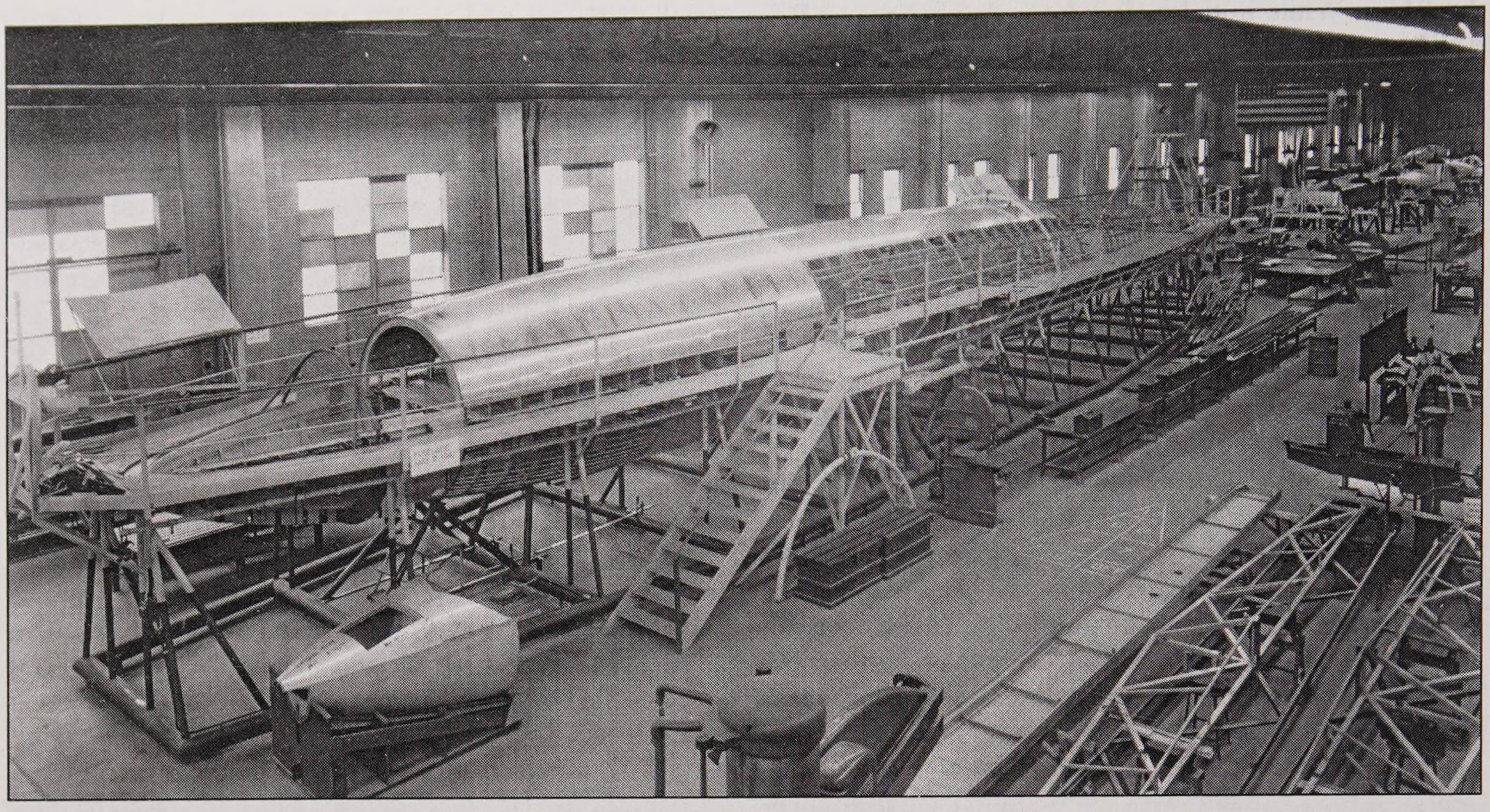
Another significant difference was the design of the passenger aircraft's windshield. Originally featuring the production XF-12's novel streamlined upper clamshell fairings, the RC-2 reverted to a more traditional airliner configuration with two large bifurcated windshield panes and four large side windows fitted to the compound curvature of the forward fuselage. (This windshield configuration appeared for the first time operationally on the Learjet 24 executive aircraft which was first flown in 1964.) Finally, each engine was to have only one General Electric turbo-supercharger rather than the XF-12's two per engine.

With a perfectly circular fuselage cross section and maximum fuselage diameter of 10 feet 3 inches, the interior width of the RC-2's passenger cabin at the mid-section would have been similar to both the Douglas DC-6 and Lockheed Constellation, but not the larger Boeing Stratocruiser. Fitted with an intimate-sized passenger lounge featuring club-style (face-to-face) seating between the pullheads of the wing carry-through section in the mid-fuselage, the RC-2's cabin was arranged to maximize usable space. Payload of passengers and cargo for a 4,150-mile flight was projected to be 10,000 pounds.

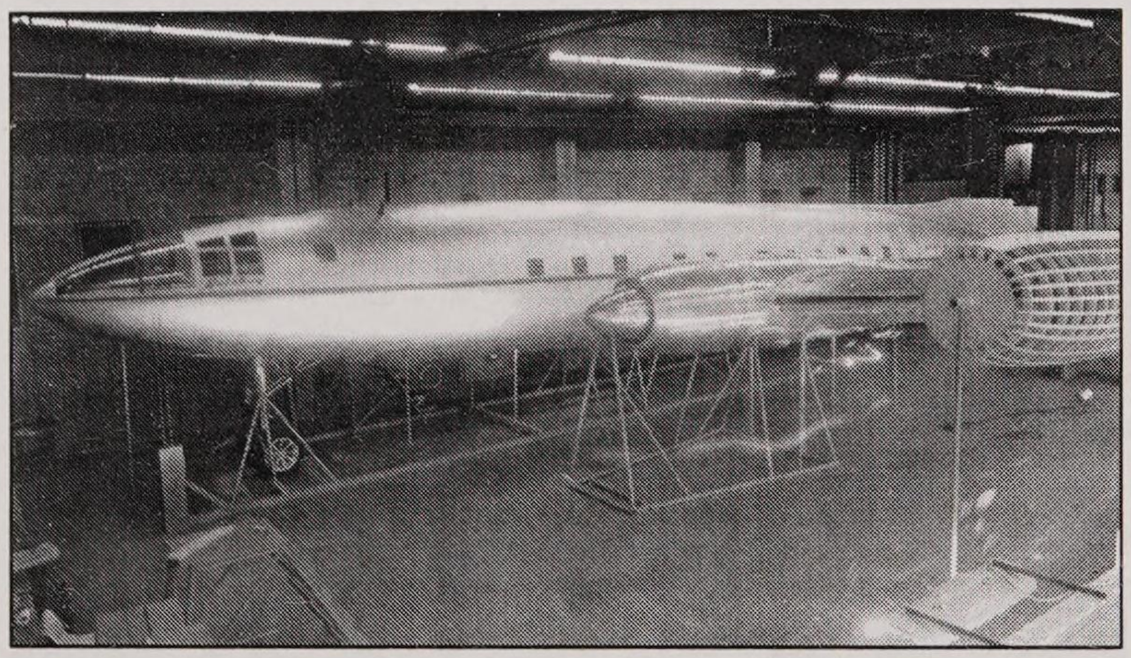
While the cabin layout featured three rows of standard four-across airliner seating in the forward cabin and five rows in the longer aft cabin, the club seats held eight

An American Airlines Rainbow climbs for the heavens in this dramatic artist's rendering. Showing the same nose and shorter forward fuselage as the military XR-12, this depiction of Republic's "Airliner of the Future" still conveyed the immense speed and performance of the RC-2. (Craig Kodera Collection)

Similar view of the real airliner that would have shared the skies with the Rainbow by the early 1950s, the incomparable 80-passenger Douglas DC-6B. This airliner was slower, and had less range than the proposed RC-2, but flew profitably in passenger service for nearly two decades. (Author Collection)



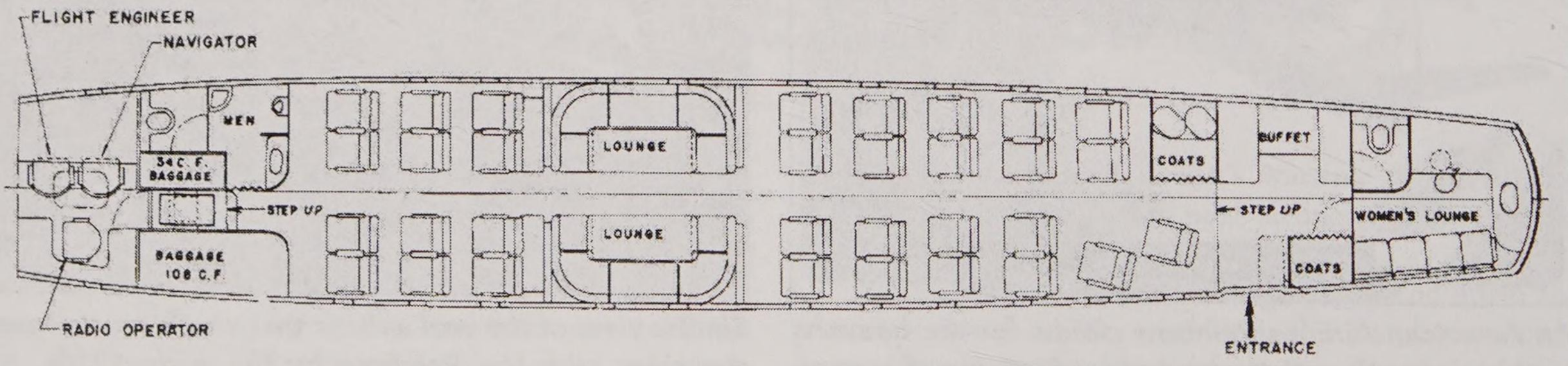
Republic RC-2 mockup takes shape at Farmingdale and was used to spur serious interest by prospective commercial airline customers. (Cradle of Aviation Museum via Dennis R. Jenkins)



Nearly completed mockup of the RC-2 begins to assume the lines of the actual aircraft, complete with engine nacelles. Note square windows. (Cradle of Aviation Museum via Dennis R. Jenkins)

more passengers to make the 40-passenger payload. A spacious women's lounge and lavatory was located at the extreme aft end of the cabin, while a smaller separate men's lavatory was located forward on the right-hand side just behind the cockpit. Stowage of additional carry-on baggage was provided in two separate lockers in the forward cabin located immediately aft of the cockpit, while coat closets and a galley were located adjacent to the passenger boarding door at the rear of the fuselage.

An ample 265 cubic feet of cargo and baggage could be stowed in five separate compartments below the cabin floor, all of which were pressurized. A 93-cubic-foot main cargo compartment was located below the forward fuselage just ahead of the wing, while a 65-cubic-foot compartment for oversize cargo and baggage was located



Interior floor plan shows a spacious, yet intimate airliner cabin with seats for 40 passengers. At a cost of $1.25 million each in 1946, the Rainbow would've had to fly at load factors of nearly 100 percent to attain profitability—a dire challenge at that time. (Cradle of Aviation Museum via Dennis R. Jenkins)

below the aft fuselage. Two smaller compartments were located directly under the wing carry-through structure, with the 27-cubic-foot forward section being for small cargo, and the 37-cubic-foot aft section housing small-sized baggage. A 43-cubic-foot compartment for overflow baggage was located below and behind the wing.

The flight crew was to board the Rainbow via a separate military-type hatch and integral boarding ladder located in the fuselage underside, just aft of the nose landing gear well. In actual airline operation, however, it probably would have been more feasible for the flight crew to enter the airplane through the main boarding door. Crew complement for the RC-2 would have been comprised of seven people—captain, first officer (co-pilot), flight engineer, navigator, radio operator, and two stewardesses, making 47 "total souls on board" a full flight. (This terminology is still used in airline parlance today, indicating the total number of people on board, but acknowledging that the aircraft could be carrying full coffins in the baggage compartment, should there be a crash investigation.)

As for the RC-2's performance, unlike the first generation of U.S. jet airliners that made their debut 12 years after the XF-12's inaugural flight, the Rainbow would have been able to operate from any major airport runway in the world in 1948. Powered by the even more potent Pratt & Whitney R-4360-59 engines, the RC-2's ground run to clear a 50-foot obstacle during a maximum-weight takeoff was only 4,300 feet. Landing rollout after clearing that same 50-foot obstacle was only 3,000 feet, well within the limits of any large airport at the time. Stalling speed was claimed to be a stately 95 mph.

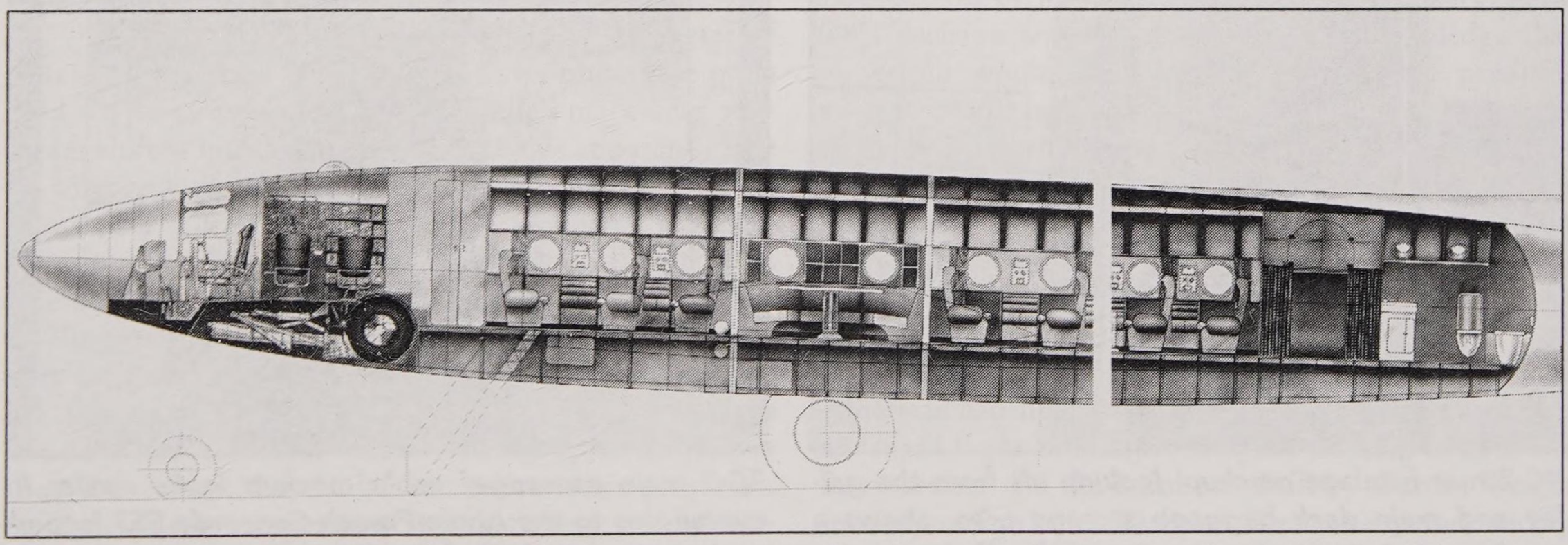
Airline Orders Appear

By September 1945, Republic was confident enough in the promise of the RC-2's development that President Alfred Marchev and Chief Engineer Alexander Kartveli assembled a team to meet with leading U.S. airline executives for marketing the new airliner design. Performance projections offered to these carriers included flight times of six hours nonstop from New York to Los Angeles (then a long 12-hour one-stop journey in a four-engine propliner), and only nine hours nonstop from New York to Paris or London. Examples of flight times on other U.S. domestic routes included San Francisco to Washington, D.C., in five hours; Los Angeles to Chicago in four hours; and New York to Miami in only three hours—all nearly half the flight times of existing piston-powered airliners then in service.

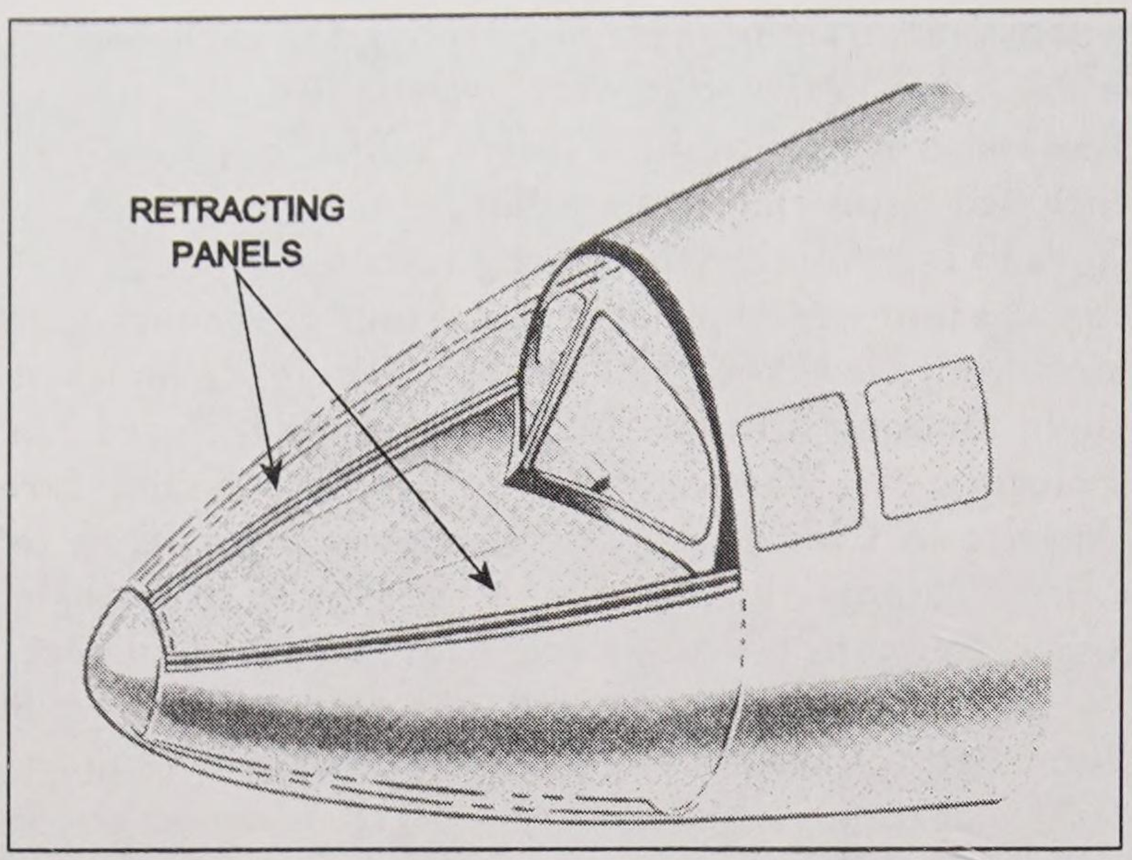
By the mid 1940s, a number of positive factors had combined to create a favorable marketing environment sufficient for an advanced airliner such as the Rainbow, and several U.S. carriers took notice. As America's "chosen instrument" symbolizing global air transportation and worldwide aviation progress, Pan American World Airways, under the ever-present guidance of its legendary founder, Juan T. Trippe, sought to maintain its supremacy by procuring aircraft with advanced levels of technology and performance.

Carrying nearly one million passengers throughout its vast international route system annually, Pan Am and the Rainbow initially seemed like a perfect fit. After the airline's engineering and operations staff scrutinized the RC-2's specifications and performance criteria and reviewed the full-scale passenger cabin mockup at Farmingdale, the airline placed a provisional order for six Rainbows with options for another twelve aircraft. This, in no small part, was to offer stronger competition to rival TWA's new transatlantic service being flown by the improved 60-passenger model 749 Lockheed Constellation. These flights had become an especially thorny issue because Pan American had inaugurated that very service in January 1946.

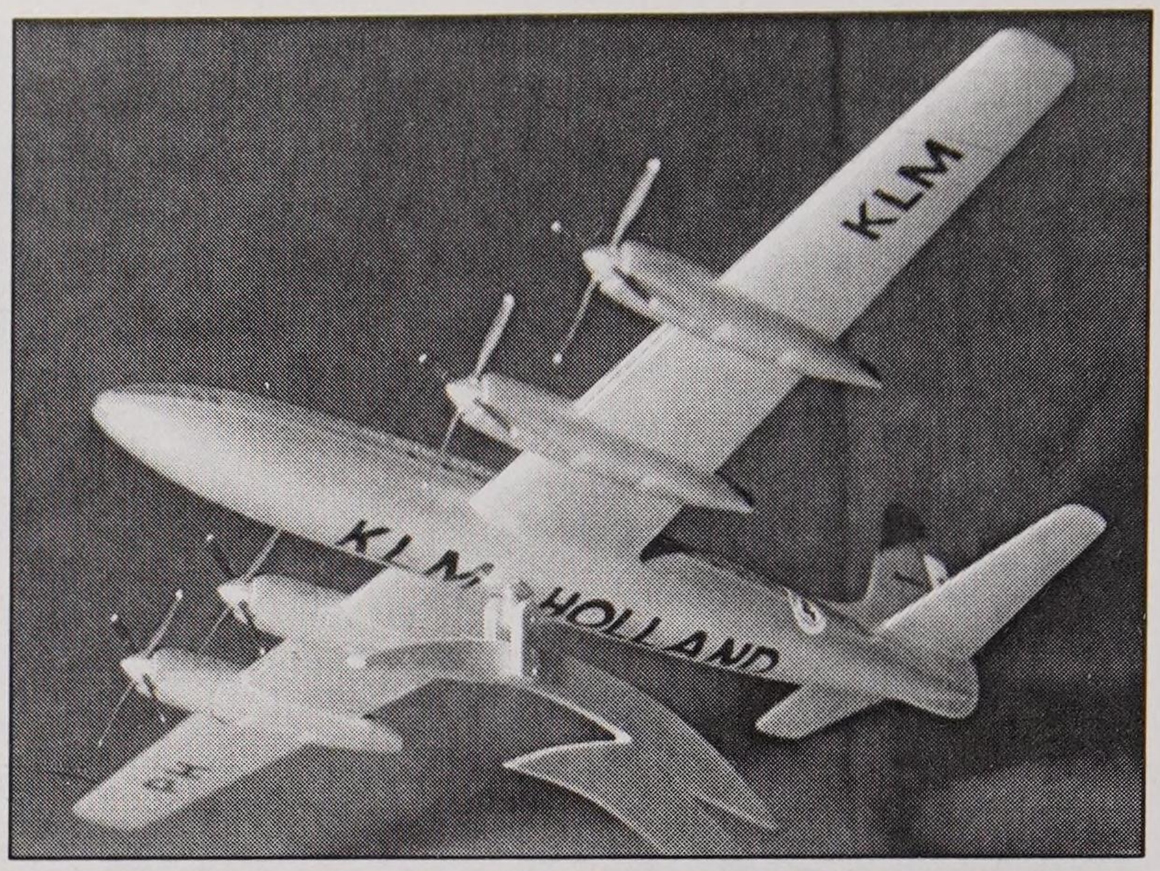
The first company to express serious interest in the RC-2, however, had been American Airlines, under the



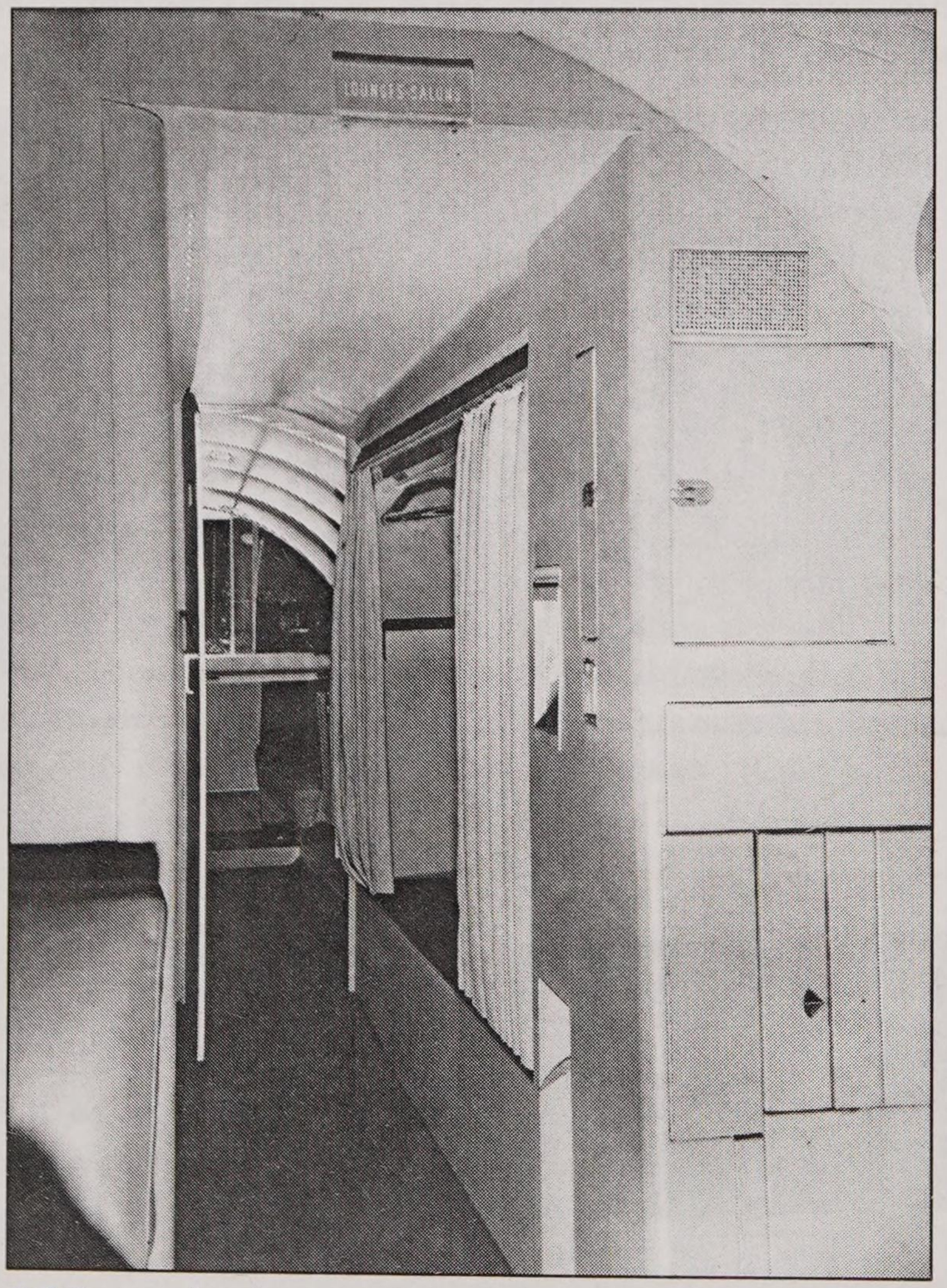
Inboard profile of the RC-2 Rainbow airliner reveals a comfortable and luxurious interior space in which passengers could spend several hours aloft being whisked to some exotic locale at 400 mph. Use of the military XF-12 nose and cockpit section was often seen in the airliner proposals, as were either round or square passenger windows in any number of different configurations. (Cradle of Aviation Museum via Dennis R. Jenkins)



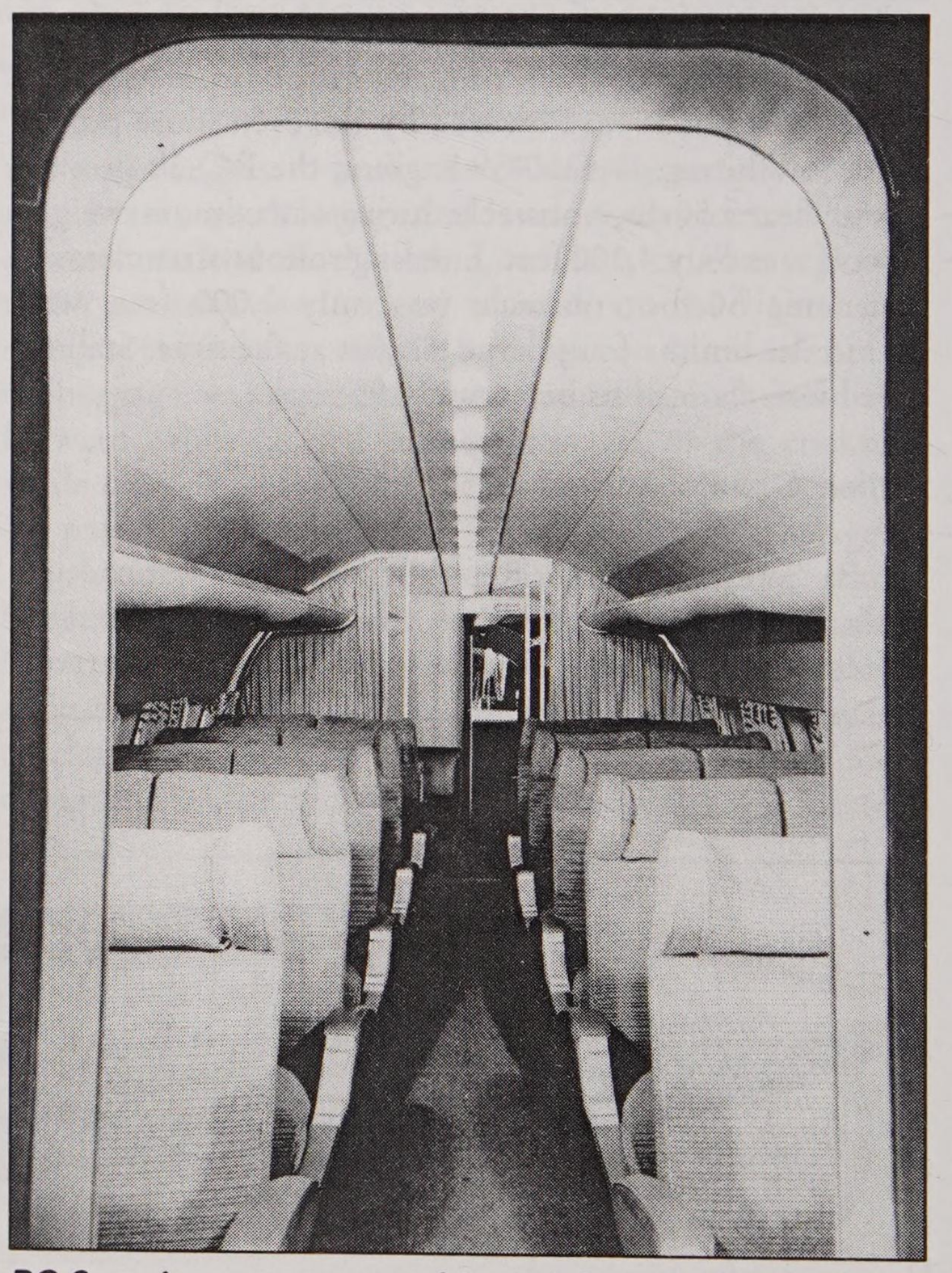
This Republic technical drawing was labeled "Production Nose" and would have been used on the RC-2, with the upper retractable sections stowed during low-speed operations at night, or in inclement weather. The RC-2's nose configurations seemed to change weekly at this stage of the aircraft's development. (Republic courtesy of Graham White)



Stunning photo of a 1/72-scale KLM Royal Dutch Airlines RC-2 Rainbow proposal model built by the Republic factory model shop. Note airline name painted on bottom of fuselage, as is used today by Emirates Air Lines on the underside of their giant 500-passenger Airbus A380 Super Jumbo Jet. (Cradle of Aviation Museum)



RC-2 rear fuselage mockup, looking aft from the galley and main deck baggage storage area, shows a much more intimate interior space than larger, more roomy airliners such as the Boeing Stratocruiser or even the Douglas DC-6. (Cradle of Aviation Museum via Dennis R. Jenkins)



RC-2 main passenger cabin mockup looks similar in overall size to the Anglo-French Concorde SST (supersonic transport) with four-abreast seating and barely ample headroom in the fore and aft sections of the cabin. Note overhead cabin lighting. (Cradle of Aviation Museum via Dennis R. Jenkins)

RC-2 cockpit mockup shows a very conventional 1940s-era instrument panel configuration. Outer Plexiglas nose fairing can be seen forward of the large two-pane inner main windshield. The military XF-12 had smaller individual instrument panels for the pilot and co-pilot, similar in layout to the ***Boeing B-29.*** (Cradle of Aviation Museum via Dennis R. Jenkins)

leadership of its equally legendary president, C. R. Smith. Also faced with stiff competition from TWA's 60-passenger Constellations on its transcontinental routes, American was relegated to flying slower, unpressurized 44-passenger Douglas DC-4s while awaiting delivery of newer pressurized DC-6s that would offer only comparable performance to TWA's Connies. Additionally, American Overseas Airlines, the international division of the U.S. domestic carrier, could use the Rainbow from East Coast U.S. cities to transatlantic destinations on its routes to Europe.

In July 1946, American Airlines placed a letter of intent to purchase 20 RC-2 Rainbows plus spare parts and support equipment, and Republic's marketing program shifted into high gear. Despite this apparent surge in interest coupled with intense media coverage within the airline industry and great expectations by the traveling public, Republic's order book never advanced past these 38 airplanes. This represented a backlog of $26 million—in itself an impressive figure, but far below any potential break-even point for an airliner program of this magnitude. Republic was surprised that the world's major airlines weren't lining up in droves to buy RC-2s, lest they be left in the economic propwash of their closest competition. But there were other insidious factors at work.

Tempering the jubilation of the recent Allied victory was the sobering shadow of a deepening national economic recession that soon rendered America's airline industry on the ropes, as fewer and fewer people were able to afford the cost of traveling by air. The standing glut of available surplus military transports (see sidebar "Air Travel and the Surplus Transport Market"on page 101) forced airline leaders to come to the hard realization that "cost" trumped "performance," and that operating a fleet of $1.25 million airliners was simply not going to lead to profitability.

The proverbial axe began to fall on the Rainbow program with American Airlines' announcement of the cancellation of its 20-aircraft order in February 1947. This decision was made with the full knowledge that American would have to pay considerable penalties since Republic had already completed almost 90 percent of the RC-2's production tooling. The immediate fallout from this cancellation was a significant jump in the unit cost of each airplane for Pan American, and despite that airline's announcement in the press to the contrary in March 1947, its order for six RC-2 airliners and options was also canceled.

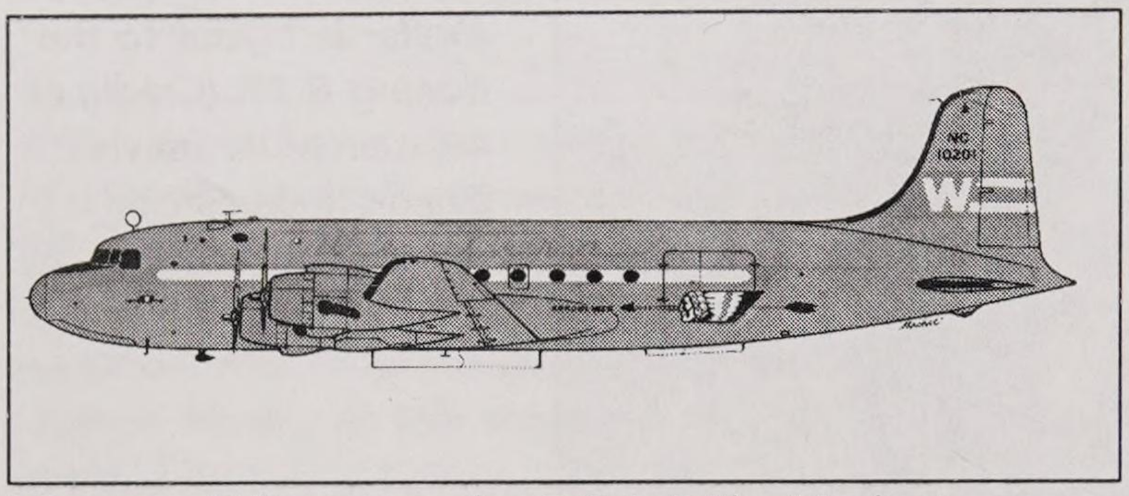
To make matters even more complicated, Pan American had also just announced plans to purchase new advanced flight simulators for pilot training in both the Stratocruiser and the Rainbow. Built by Curtiss-Wright in conjunction with Dehmel Electronics, and widely used by the Army Air Forces, these fully equipped non-motion simulators would have been the first ever used for cockpit procedural training of airline crews flying large four-engine commercial transports.

In a string of crushing blows to both the XR-12 and RC-2 programs, the airline order cancellations combined with the loss of any military production contracts firmly brought the curtain down on Republic's hopes of ever building a commercial airliner on Long Island.

The Would-Be Competition

To best understand what kind of superlative performance the RC-2 Rainbow would have offered the world's airlines in 1948, let's examine the contemporary passenger aircraft that would have been the Rainbow's primary competition. Eliminating smaller twin-engine local service and regional aircraft such as the Douglas DC-3, Martin 404, and Convair 240, I focus on the larger, four-engine, long-range airline transports just entering passenger service at that time. Using specifications and data from Pan American World Airways, here are the airliners that would have been flying across the world's premier air travel routes in the late 1940s.

Douglas DC-4



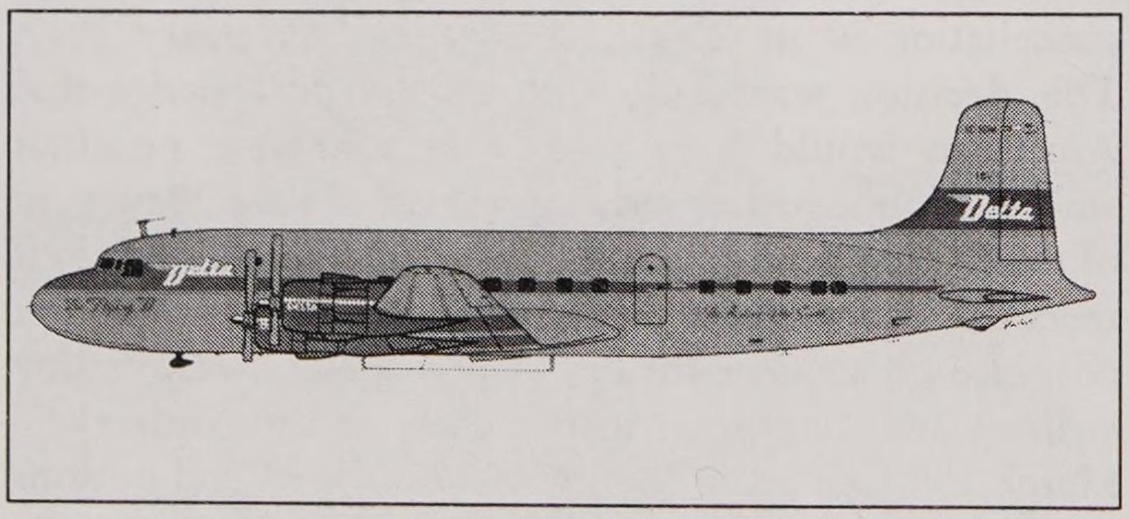
Western Airlines Douglas DC-4. (Mike Machat)

While not a true intercontinental airliner (or even transcontinental in the United States, for that matter), the DC-4 is included here because it served as the major front-line domestic transport for most U.S. and foreign carriers in the years immediately following World War II. Hence, I include this airplane to serve as the baseline for a comparison.

This rugged and reliable aircraft was used primarily on shorter U.S. domestic routes while carrying up to 44 passengers, plus two pilots, a flight engineer, and a stewardess. In addition to American Airlines and Pan Am, surplus DC-4s were also acquired by United, Delta, TWA, Eastern, and Northwest. However, it was the American and Pan Am orders that ultimately affected the outcome of Republic's RC-2 program.

Length	94 feet
Wingspan	118 feet
Height	29 feet
Passenger Cabin Width	9 feet 10.5 inches
Powerplant	Pratt & Whitney R-2000-15 Twin Wasp
Rated Horsepower	1,450 each
MGTOW	73,000 pounds
Cruise Speed	215 mph
Pressurized	No
Service Ceiling	10,000 feet
Passenger Capacity	44
Range	2,000 statute miles
Manufactured	Santa Monica, California
First Flight	14 February 1942 (C-54)

Douglas DC-6

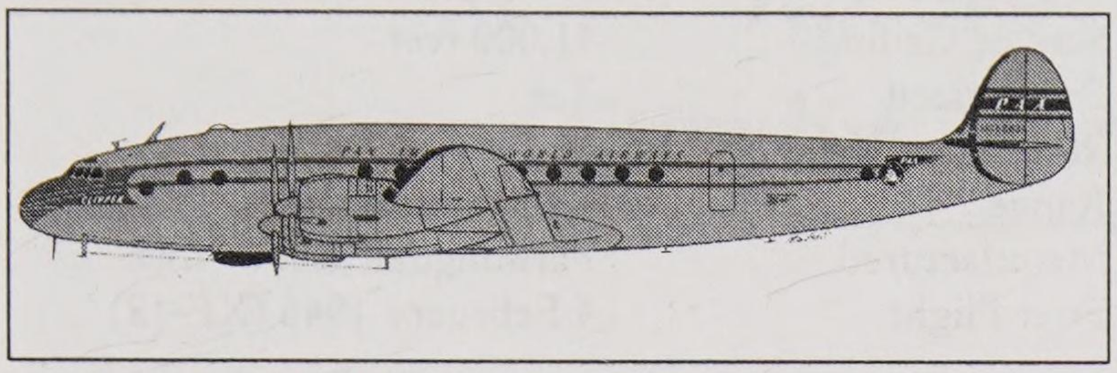


Delta Airlines Douglas DC-6. (Mike Machat)

Essentially a "stretched" and more powerful version of the four-engine DC-4, the DC-6 was the first Douglas airliner to offer passengers the comfort of a fully pressurized cabin. It was also the first Douglas airliner with a cruise speed faster than 300 mph. An improved and lengthened version called the DC-6B went into service in 1953 and emerged to become the world's ultimate piston-powered airliner in terms of efficiency and operational reliability. Originally a mainstay of the world's major airline fleets, the DC-6B was used on second-level routes by several U.S. carriers well into the 1960s.

Length	101 feet
Wingspan	118 feet
Height	29 feet
Passenger Cabin Width	9 feet 10.5 inches
Powerplant	Pratt & Whitney R-2800 Double Wasp
Rated Horsepower	2,100 each
MGTOW	97,200 pounds
Cruise Speed	328 mph
Pressurized	Yes
Service Ceiling	24,000 feet
Passenger Capacity	56
Range	2,200 statute miles
Manufactured	Santa Monica, California
First Flight	15 February 1946

Lockheed 749 Constellation

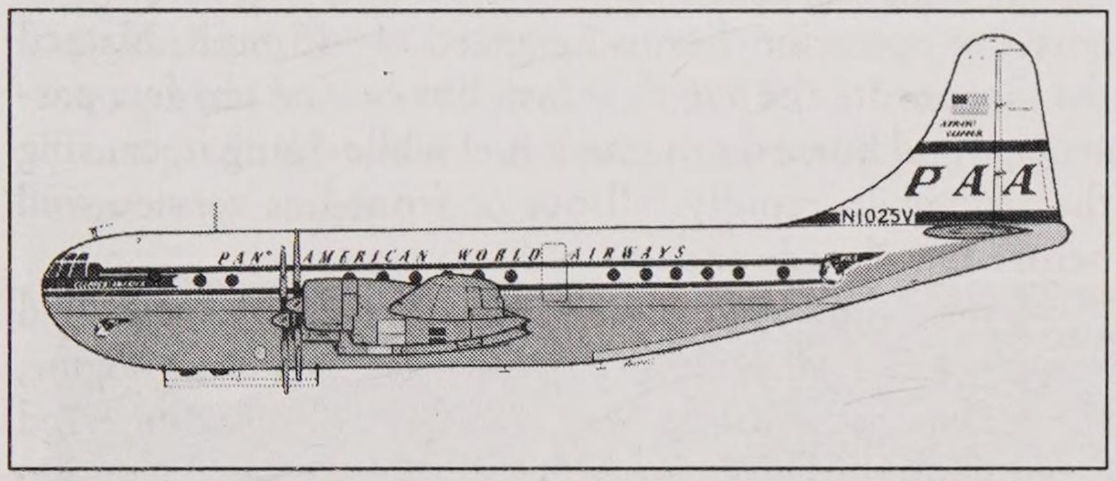


Pan American Lockheed 749 Constellation. (Mike Machat)

Lockheed began producing civil versions of its C-69 military transport after that aircraft served with the Army Air Forces toward the end of World War II. These C-69 Constellations were given to both TWA and Pan American to augment their fleets of smaller, slower DC-3s and DC-4s, and to add much-needed capacity to their routes during the postwar growth of commercial air travel. The Constellation looked more modern and elegant than the competing Douglas liners and was fully pressurized as well. The Connie also featured sleeping berths for longer night and trans-atlantic operations.

Length	95 feet
Wingspan	123 feet
Height	24 feet
Passenger Cabin Width	10 feet 8.6 inches (at its widest point)
Powerplant	Wright R-3350-18
Rated Horsepower	2,500 each
MGTOW	107,000 pounds
Cruise Speed	300 mph
Service Ceiling	21,000 feet
Pressurized	Yes
Passenger Capacity	57
Range	3,000 statute miles
Manufactured	Burbank, California
First Flight	9 January 1943 (C-69)

Boeing 377 Stratocruiser

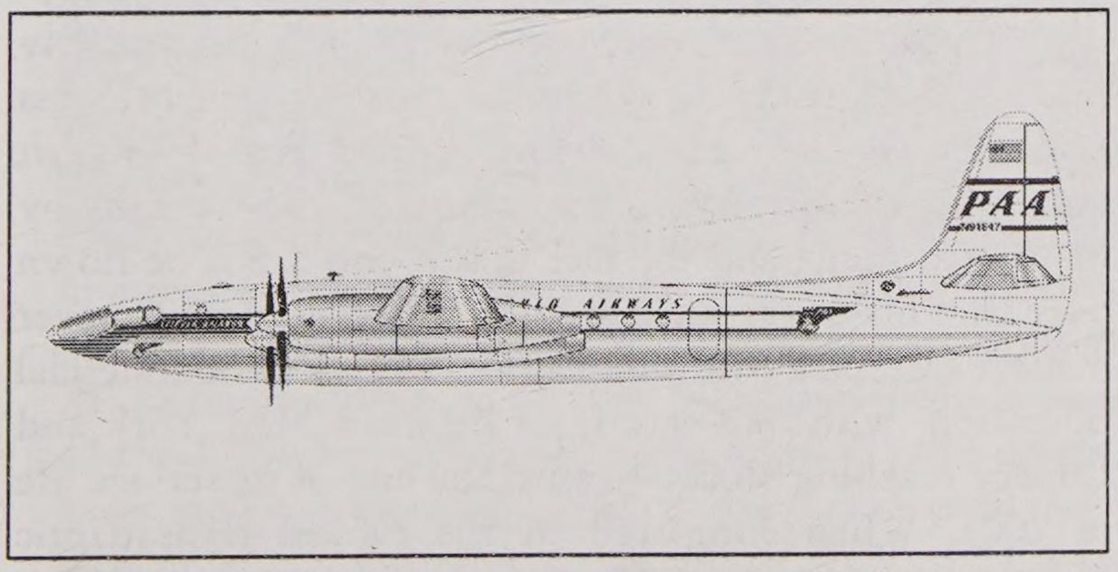


Pan American Boeing 377 Stratocruiser. (Mike Machat)

The Stratocruiser began its career as the military C-97 Stratofreighter cargo transport. Although the C-97 came along too late to become operational in World War II, it entered service with the Air Force as a much-needed aerial-refueling tanker. The Stratocruiser was one of the largest aircraft in the world when Pan American ordered 20 of the new double-deck airliners in November 1945. Powered by the same Pratt & Whitney R-4360 radials as the XF-12, the "Strat" featured a novel and popular lower-deck lounge, and offered new levels of roominess, comfort, and luxury for airline passengers.

Length	110 feet
Wingspan	141 feet
Height	38 feet
Passenger Cabin Width	10 feet 6 inches
Powerplant	Pratt & Whitney R-4360-59 Wasp Major
Rated Horsepower	3,500 each at takeoff
MGTOW	142,500 pounds
Cruise Speed	340 mph
Service Ceiling	31,000 feet
Pressurized	Yes
Passenger Capacity	86
Range	3,000 statute miles
Manufactured	Seattle, Washington
First Flight	15 November 1944 (C-97)

Republic RC-2 Rainbow



Republic RC-2 Rainbow. (Digital illustration by Tony Landis)

The following specifications and performance data were projected for the RC-2. Although never proven in actual airline service, they are presented here to show the quantum leap in performance had the Rainbow been produced and flown in 1948. Note also that the RC-2 would have been the only U.S. four-engine airliner manufactured east of the Rocky Mountains. (The Martin 404, built near Baltimore, Maryland, was a twin-engine aircraft.)

Length	99 feet	Cruise Speed	420 mph
Wingspan	129 feet	Top Speed	450 mph
Height	30 feet	Service Ceiling	41,000 feet
Passenger Cabin Width	9 feet 9 inches (at its widest point)	Pressurized	Yes
		Passenger Capacity	40
Powerplant	Pratt & Whitney R-4360-59 Wasp Major	Range	4,150 statute miles
		Manufactured	Farmingdale, New York
Rated Horsepower	3,250 (3,500 at takeoff)	First Flight	4 February 1946 (XF-12)
MGTOW	113,250 pounds		

Comparing the RC-2's specifications and performance data with its three major competitors makes a compelling case for the Republic airplane as a world-class airliner when based solely on performance. Yes, the RC-2's cruising speed would have been nearly 100 mph faster than that of the Boeing Stratocruiser, and yes, its service ceiling would have been nearly twice that of the other aircraft. However, with only 40 seats configured in a single-class layout, the RC-2's seat-mile cost may have been high enough to warrant having to charge passengers a "premium fare" for flying in an airliner of that performance level.

In the final analysis, perhaps the largest single impediment to the RC-2 was cost. With a brand-new DC-6 costing $325,000, the $1.25 million Rainbow became the Concorde of its day. Sleek, with impressive performance, and a symbol of exceedingly high technological pride, both the RC-2 in 1948 and the Anglo-French Concorde supersonic airliner some 20 years later were trapped in a lofty class all by themselves. As impressive as it may have been in all other aspects, the Rainbow was simply overpriced for the times. Consequently, the airplane became too impractical for inclusion into the world's existing airline fleets, even had it been built.

The Need for Speed — A Bitter Lesson

"Higher, faster, and farther" was the mantra for aeronautical engineers during World War II, and the quest for ultimate aircraft performance did not abate in the years following the war. As quoted in an April 1946 Republic report entitled *Engineering Aspects of the Development of the Rainbow* by Chief Engineer Alexander Kartveli, "We believe that speed is the only justification [for] air travel and it is this idea that led to the conception of the Rainbow. We have, therefore, concentrated all of our knowledge, experience, and efforts to design a sound airliner which will bring to commercial use altitudes and speeds so far only attainable by military pursuit airplanes. It is hoped that when the Rainbow is in actual service, it will help our national air lines to maintain supremacy in the highly competitive field of air transportation."

As history has shown in each decade since the XR-12 last flew, the siren song of faster aircraft cruising speeds often lured airline corporate minds into a false sense of reality. For instance, at the beginning of the commercial jet age in the early 1960s, first-generation Boeing 707s and Douglas DC-8s cruised at about 535 mph; certainly a giant leap in performance over their piston-powered predecessors.

Convair introduced two slightly smaller jetliners, the 880 and 990, with the latter being powered by General Electric turbofan engines and equipped with four aerodynamic design innovations called anti-shock bodies, or "speed pods." Mounted on the wing's inboard trailing edges, these devices resembled overturned canoes that significantly enhanced drag reduction, giving the 990 an amazing operational cruising speed of 615 mph. Named the Coronado, the 990 flew fast, but carried too few passengers and burned too much fuel while doing it, causing the airliner to rapidly fall out of front-line service well before that decade ended.

By the mid 1960s, both Boeing and Lockheed had designs for a large 200- to 300-passenger, four-engine, Mach 2.5, supersonic transport (SST), but Boeing emerged as the winning contractor with a variable-geometry design called the 2707 (a Mach 2 airplane as revolutionary as the 707). However, with the country caught up in the political and economic turmoil of the Vietnam War, coupled with an emerging environmental movement raising alarming concerns about the impact of such an airplane on the ecosystem, the challenges of moving forward on such a project became too formidable. Despite having 115 orders on the books from 25 of the world's leading airlines, the 2707 program was scrapped in 1971, leaving a smaller airplane from Europe to claim the crown as the world's only operational SST.

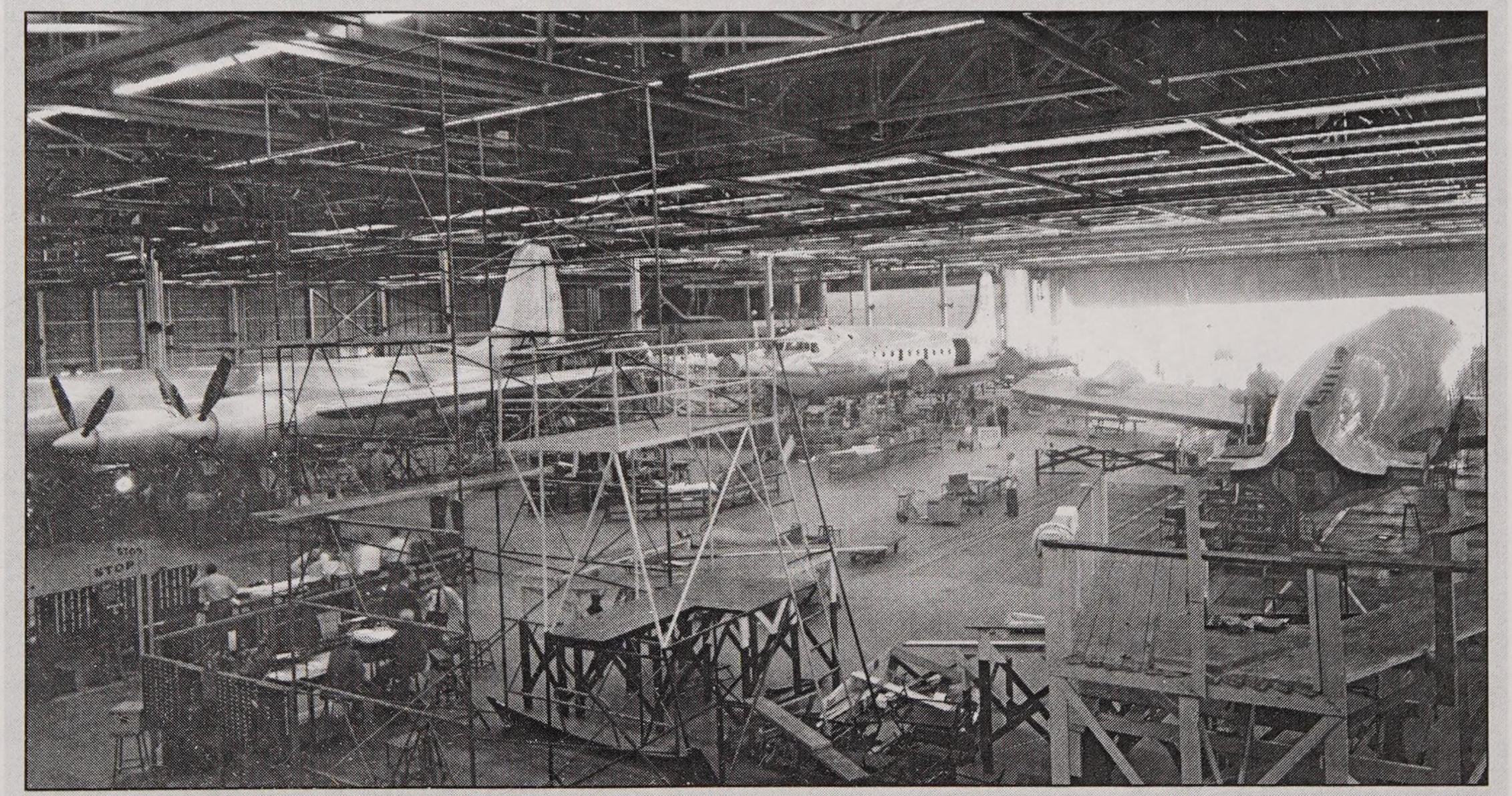
The incomparable Anglo-French Concorde supersonic airliner entered commercial service in 1976, carrying 100 passengers at speeds of Mach 2, or approximately 1,300 mph. A stunning symbol of technological prowess and national pride for the English and French aircraft industries, the Concorde was hampered operationally by its limited range and the fact that it could not be flown over land masses at supersonic speeds. The aircraft never made a sustained profit in nearly 30 years of commercial operation, with one-way fares between New York and Europe reaching $6,000 toward the end of its service life in 2003. When compared to the typical transatlantic "super-saver" fare of $495 on a subsonic 400-seat Boeing 747 Jumbojet, the equation became obvious that saving

Air Travel and the Surplus Transport Market

By Jon Proctor

After World War II, a massive transfer of military transport aircraft into the airline industry took place. Most of these newly acquired surplus aircraft were twin-engine 180-mph Douglas C-47 Skytrains reconfigured into airliners with passenger seats installed in previously open cargo-carrying interiors. That in itself was ironic, as the original design template for the C-47 originated ten years earlier as a commercial airliner called the Douglas Sleeper Transport, better known as the ubiquitous DC-3. By the end of the war, there were nearly 10,000 C-47s available to airlines, with the price of these now-plentiful airplanes starting at less than $10,000 each. Carrying as many as 30 passengers in a single-class cabin, the DC-3 found its way into profitable airline service primarily on regional and inter-city routes.

For longer transcontinental and international stage lengths, there was the DC-3's larger sibling, the four-engine Douglas DC-4. A total of 1,100 of these larger and faster (although still unpressurized) transports were built by Douglas in Santa Monica, California, as C-54 Skymasters for the Army Air Forces and R5Ds for the Navy. At war's end, they became readily available to commercial customers as well, and were snapped up in large quantities by both established and upstart freight or "non-scheduled" airlines. American Airlines acquired 50 C-54s at the standard government surplus price of $90,000 each, and spent an additional $175,000 per airplane installing seats, galleys, and lavatories in newly configured passenger cabins. Pan American World Airways, an original operator of passenger DC-4s in 1940, flew 90 of the type, while other carriers acquired smaller DC-4 fleets.



In a graphic depiction of the post–World War II commercial airliner market, a bevy of Douglas C-54 Skymaster military transports undergoes conversion at Republic to become passenger-carrying DC-4 airliners as the first XF-12 (left) is prepared for its inaugural flight in January 1946. Larger, faster, and more luxurious derivations of the DC-4 and Lockheed Constellation (also originally created as a military transport) carried propliners to their zenith in the mid 1950s, but it wasn't until the first generation of commercial jet transports entered service in 1958 that an entirely new family of high-speed airliners was born. (Cradle of Aviation Museum via Dennis R. Jenkins)

three hours of flight time simply wasn't worth thousands of extra dollars.

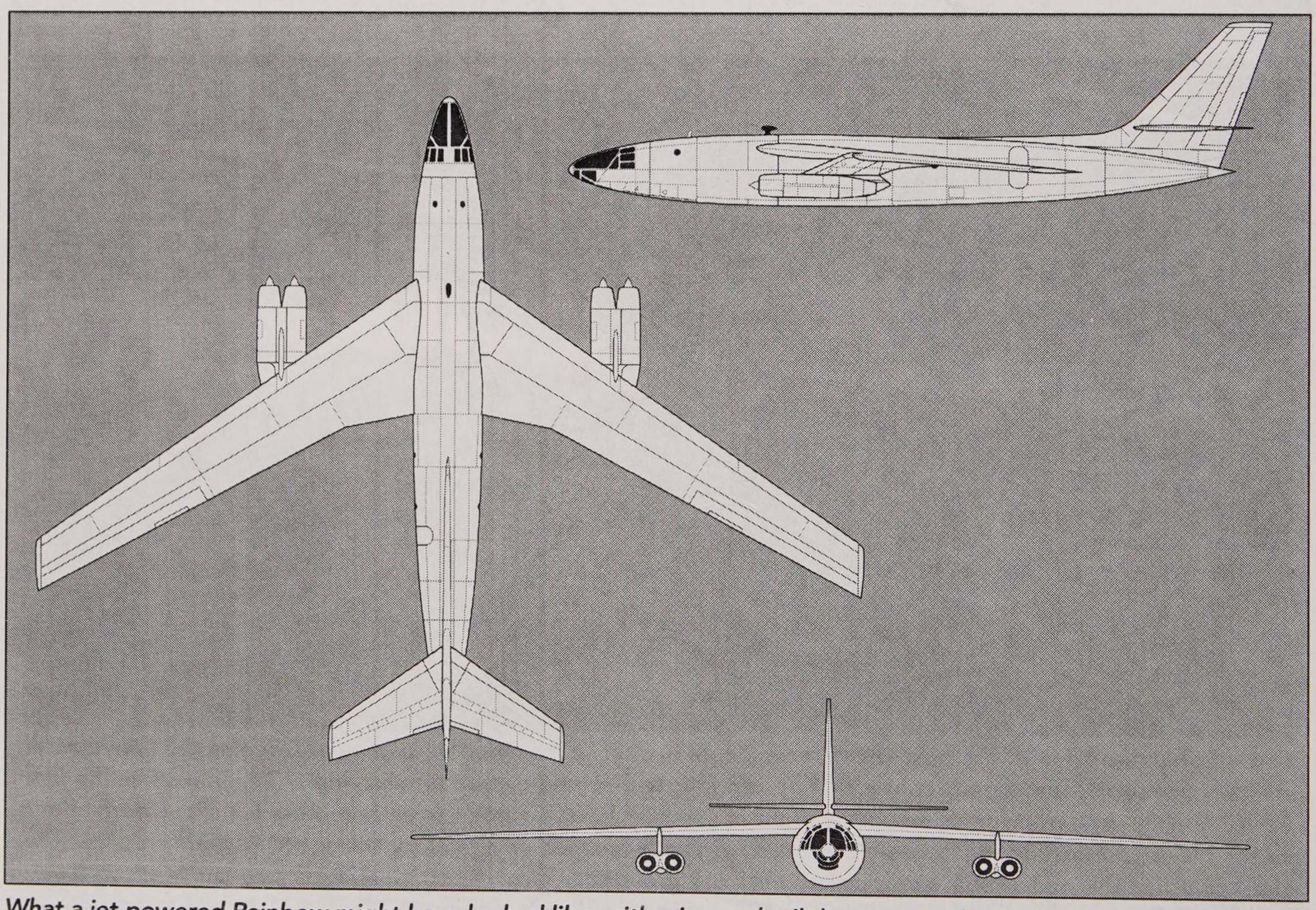
In the late 1990s, Boeing envisioned a revolutionary new airliner capable of flying at nearly the speed of sound that strangely resembled some of the radical concepts for nuclear-powered strategic bombers seen during the Cold War. Fitted with canard horizontal stabilizers, a "crank arrow" delta wing, and inward-canted twin vertical stabilizers, the 250-passenger Boeing Sonic Cruiser concept wowed crowds at the Farnborough and Paris Airshows, but failed to gain any real traction with airline executives and their tight-fisted chief financial officers. What emerged instead was an all-composite, but still subsonic, twin-engine 250-seat airliner called the 787 Dreamliner that was to offer the airline world a new paradigm of efficiency. Rolled out of the factory on 7 August 2007 (07-08-07), the trouble-plagued jetliner has yet to enter airline service as of this writing.

And so, just as it was for the RC-2 Rainbow in the late 1940s, the ever-shifting sands of airline economics coupled with national and global economic factors snuffed out the chances of success for transonic and supersonic airliners from the early 1960s through the beginning of the twenty-first century. Perhaps in another lifetime, the challenge of economically transporting large numbers of passengers from Point A to Point B at supersonic speeds will become a reality, but for now, the names Rainbow, Coronado, Concorde, and Sonic Cruiser all represent promises for a future that never came.

The Rainbow's Last Gasp

As modern and sleek as the RC-2 Rainbow may have appeared to the eye in 1946, several odd-looking advanced design studies for both turbojet and turboprop Republic airliners were proposed in 1950 and 1957, respectively. Sounding impressive on paper, they looked more like aeronautical engineers' pipe dreams at best.

One four-engine design concept in 1950 featured twin Allison T40 turboprops buried in each wing, driving contra-rotating propellers via short extension shafts extending forward from the wing's leading edge. (It should be noted that this was a very trouble-plagued powerplant for any number of military airplanes fitted with that arrangement at the time.) With a takeoff weight some 6,600 pounds lighter than the original RC-2, performance estimates were touted as being as good as the de Havilland Comet 1 jetliner then undergoing development in Great Britain, and about two years away from entering airline service.



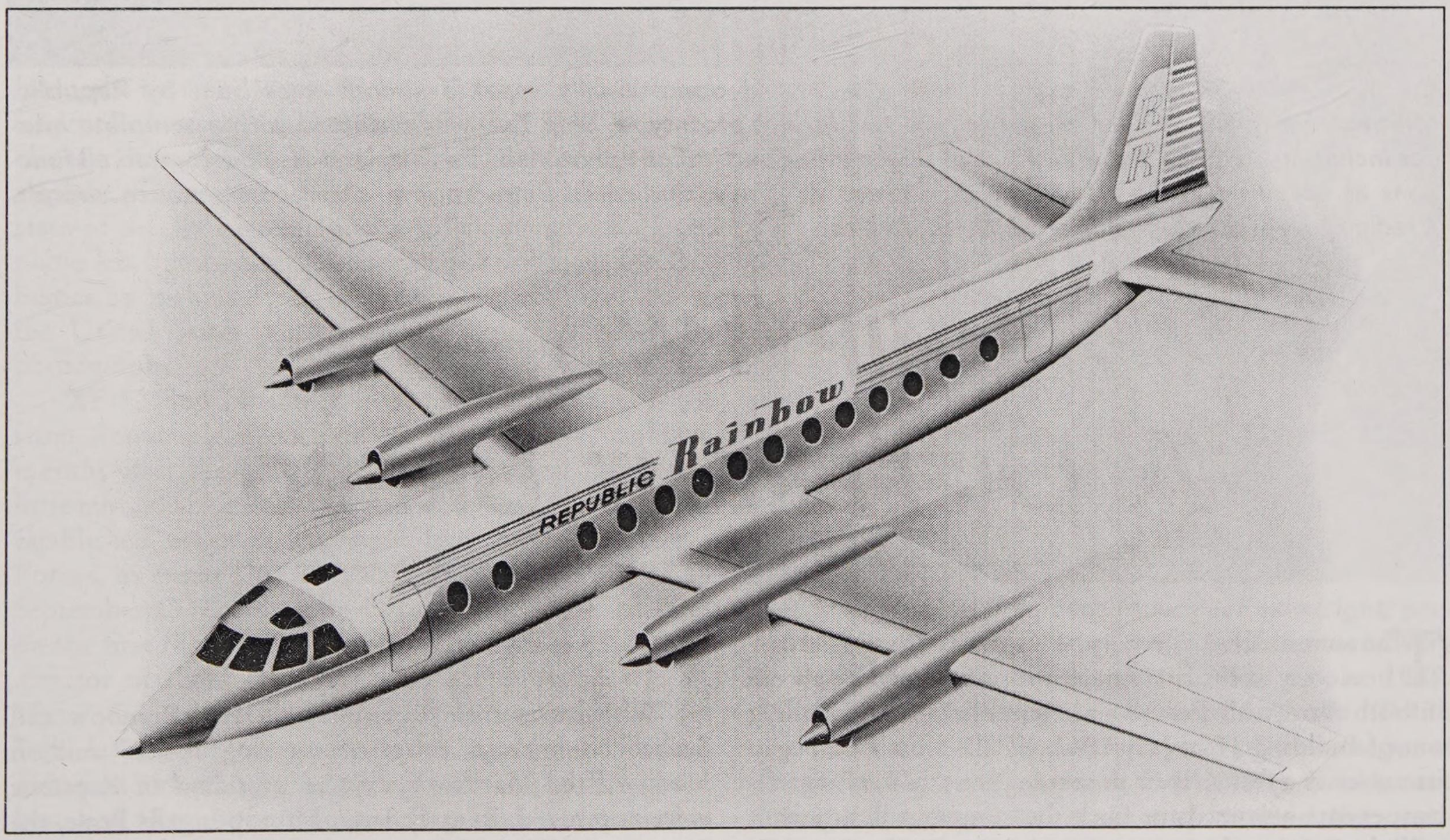
What a jet-powered Rainbow might have looked like, with wing and tailplanes swept back at a 35-degree angle and four 5,000-pound-thrust engines housed in twin pods under the wing. Rainbow meets Stratojet? Indeed! (Digital illustration by Tony Landis)

Republic's Kartveli even touted the possibility of a pure-jet version of the RC-2. Looking amazingly similar to a Boeing design study conducted that same year for a modification of its Stratocruiser called the Model 473, this concept showed an RC-2 fuselage with new wings swept back at a 35-degree angle, and four 5,000-pound-static-thrust engines mounted two-each in podded nacelles underneath the wings. Tail surfaces were swept back at 35-degree angles as well. With a cruise speed of 580 mph, Republic's design was projected to have a modest range of 2,000 miles with 40 passengers on board, and would have weighed 126,150 pounds at takeoff. Had it been built, this airplane would have embodied the same engineering philosophy Convair used when it modified its straight-wing piston-powered B-36 bomber into the swept-wing jet-powered YB-60 prototype.

As late as July 1958—only three short months before the historic inauguration of pure-jet airliner service in the United States with the Boeing 707—Republic was still beating the bushes trying to generate interest in a medium-range turboprop version of the now-defunct RC-2. Other than the general shape of the wing and horizontal stabilizer, this new concept bore little resemblance to the elegant RC-2. In fact, judging from the renderings shown on these pages, the airplane would have offered little advantage over existing turboprops and jetliners already flying in airline service. If anything, the turboprop version of what Republic was still calling the "Rainbow" looked like a homely inbred cross between the British Vickers Viscount 800 series and the French Potez 840 turboprop feederliner, with a dash of Lockheed L-188 Electra thrown in for good measure.

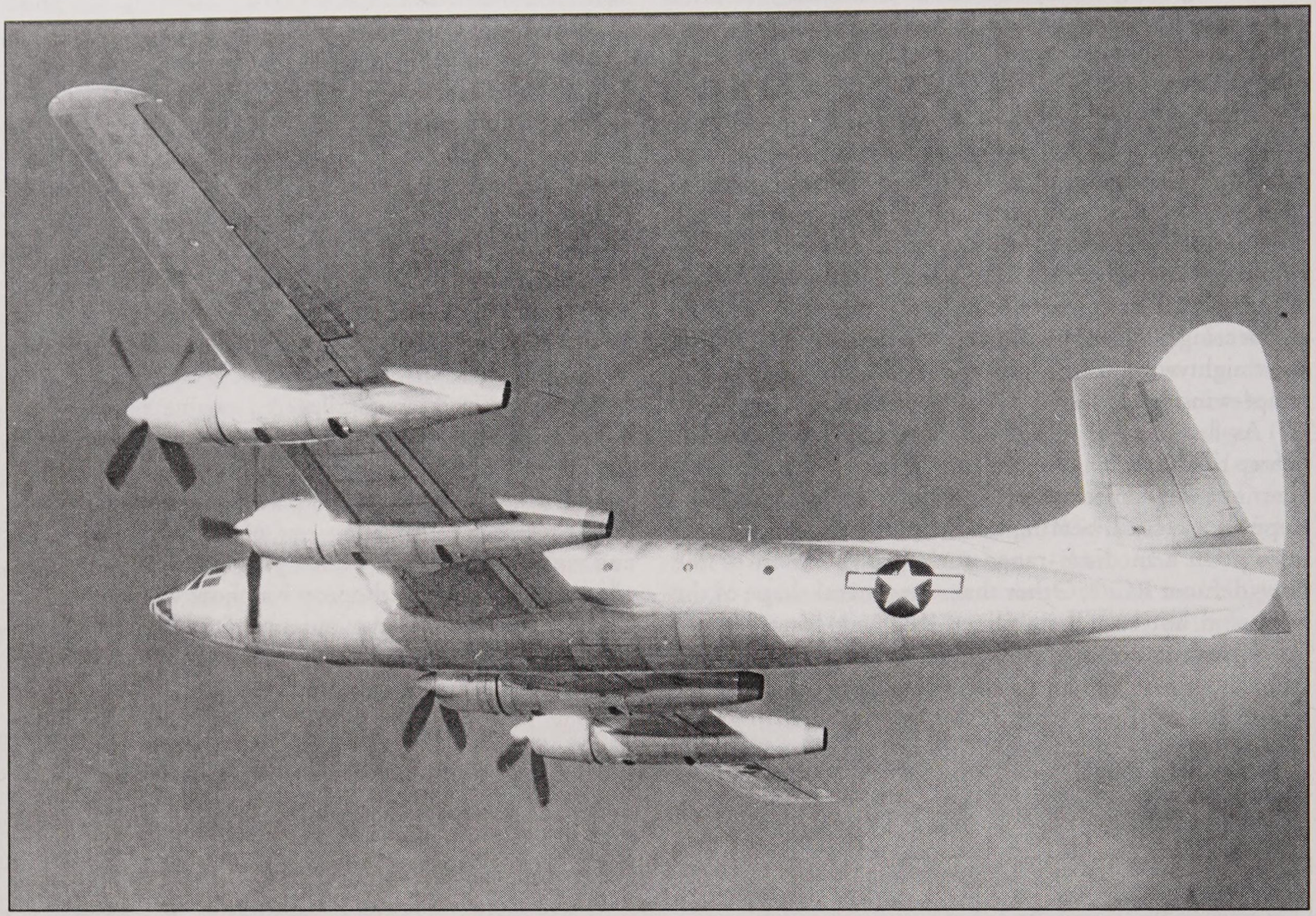
Powered by either 2,600-shaft-hp Rolls-Royce Dart R.Da.10 turboprops, or General Electric T64s, this four-engine aircraft was to weigh 77,500 pounds at takeoff (compared to the RC-2's almost 114,000 pounds), yet was to hold a maximum capacity of 80 passengers—twice that of the RC-2. (By comparison, Boeing's new 707-120 carried 120 passengers at the start.) Not only did the Republic concept closely resemble the Viscount, but it even sported large elliptical passenger windows like the British turboprop. Unlike the RC-2, however, boarding was to be accomplished through both forward and rear doors. The aircraft's cantilevered engine nacelles also bore a strong resemblance to those housing the Lockheed Electra's Allison 501 turboprops.

Marketing emphasis was placed on good short-field performance for operating out of existing small-town and regional airports. By employing wide-chord leading-edge slats, this new turboprop Rainbow would have had a takeoff distance (at maximum gross takeoff weight) of only 3,160 feet, while landing rollout would have been less than 4,000 feet at a landing weight of 74,000 pounds. Despite these initially impressive numbers, Republic's final transport design concept languished in airline boardrooms, but never left the drawing boards, much less the runways, at Farmingdale.



This 1955 turboprop proposal of the Rainbow was in name only. Looking like a cross between a Potez 840, Viscount, and Lockheed L-188 Electra, this aircraft was the dying gasp of Republic's offerings to the commercial airliner industry, and never generated any serious airline interest. (Cradle of Aviation Museum Archive)

Chapter Nine



The second XF-12 was without a doubt the largest operationally capable aircraft ever built by Republic. Although outwardly similar in appearance to the first prototype, Ship Two was outfitted with a complete interior including all aerial camera gear and a fully equipped inflight photo lab. This airplane also performed all functions as specified in the government contract for a new dedicated long-range photo-reconnaissance aircraft. (Cradle of Aviation Museum via Dennis R. Jenkins)

SHIP TWO— A DIFFERENT BREED

The second XF-12 prototype was more than just a carbon copy of the first one, for it represented a new era in both Army Air Forces and Republic history. Rolling out of Building 17 in July 1947, XF-12 Ship Two began its career as a test aircraft the same year that very significant events occurred for both the company that built it and the service that was preparing to use it. Republic changed its corporate direction, and the Army Air Forces acquired a new identity.

The Torch is Passed — Again

With losses from Republic's ill-fated Rainbow and Seabee commercial programs nearing the $7 million mark, Alfred Marchev's days as president of Republic were numbered. In early 1947, Mundy Ingalls Peale, the 40-year-old former director of Republic's Evansville, Indiana, facility, was installed as the new president, and in several bold strokes, he swiftly turned the company's

fortunes around. First was the decision to eliminate Republic's weaknesses and focus on the company's strengths by completely eradicating any non-military programs. In so doing, further efforts to sell either the RC-2 Rainbow or RC-3 Seabee ceased that year, and Seabee production was terminated. Then, with a backlog of military orders for 100 new F-84 Thunderjets, Peale chose to capitalize on the company's reputation as a consummate builder of rugged, reliable, and highly potent military fighter aircraft.

Also taking place in 1947 was Congressional approval of a major restructuring of the U.S. military's aerial assets. On 18 September, the United States Air Force was created as a completely separate branch of the U.S. armed forces. Now the Army could concentrate on its important tactical mission while the Air Force was tasked with new duties better aligned to the realities of an emerging Cold War with the Soviet Union. It was in the new Air Force organization and under this new political world order that XF-12 Ship Two entered its flight test program. The airplane was considered to have an important, if not pivotal, role as a potential photo- and intelligence-gathering aircraft for a new era.

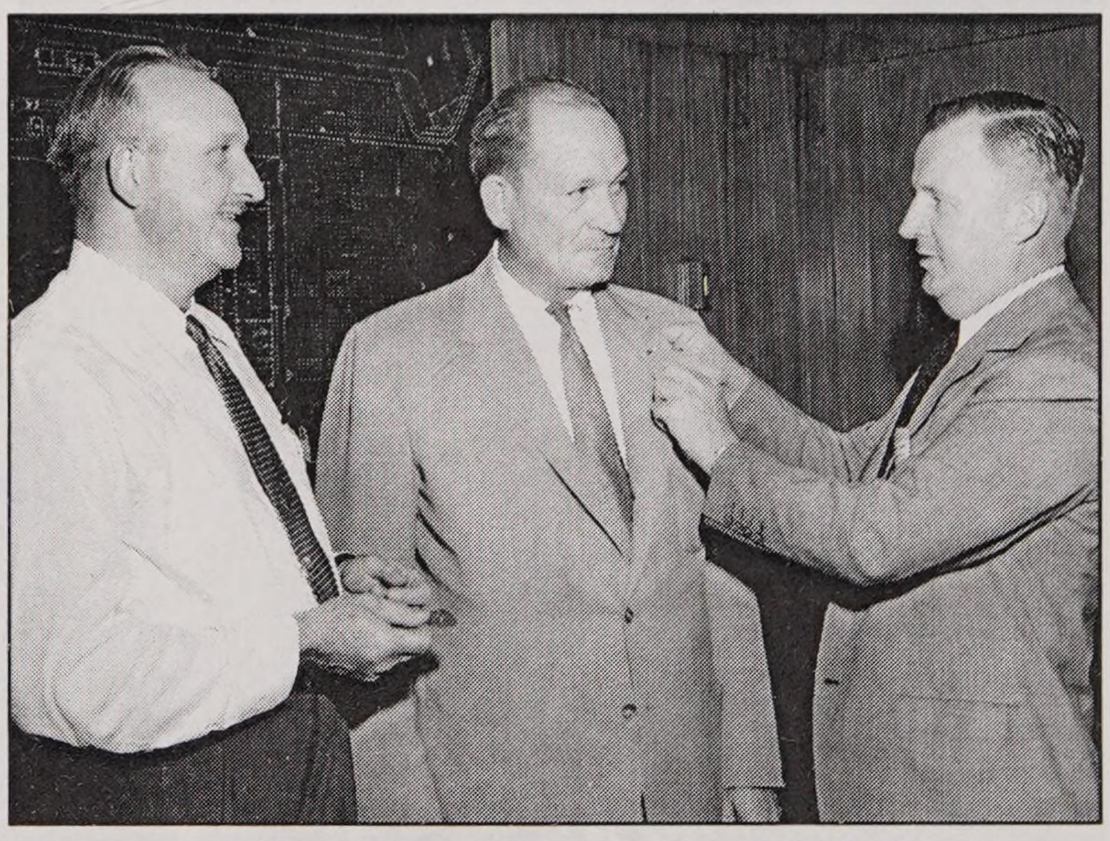
Flying Photo Lab

Although not all that apparent from the outside, the first and second XF-12 were substantially different airplanes. The second prototype's cabin and interior was much more developed than the first, completely outfitted with government-furnished equipment that made it almost mission-ready. In today's aerospace industry parlance, the first XF-12 would really have been considered a "proof of concept demonstrator," while Ship Two was closer to being a fully operational Air Force photo-recon airplane. The second XF-12 was not only fitted with state-of-the-art cameras and a fully operable onboard photo lab, but the airplane actually demonstrated its capabilities by making a non-stop high-altitude flight across the United States, all-the-while taking high-definition photographs.

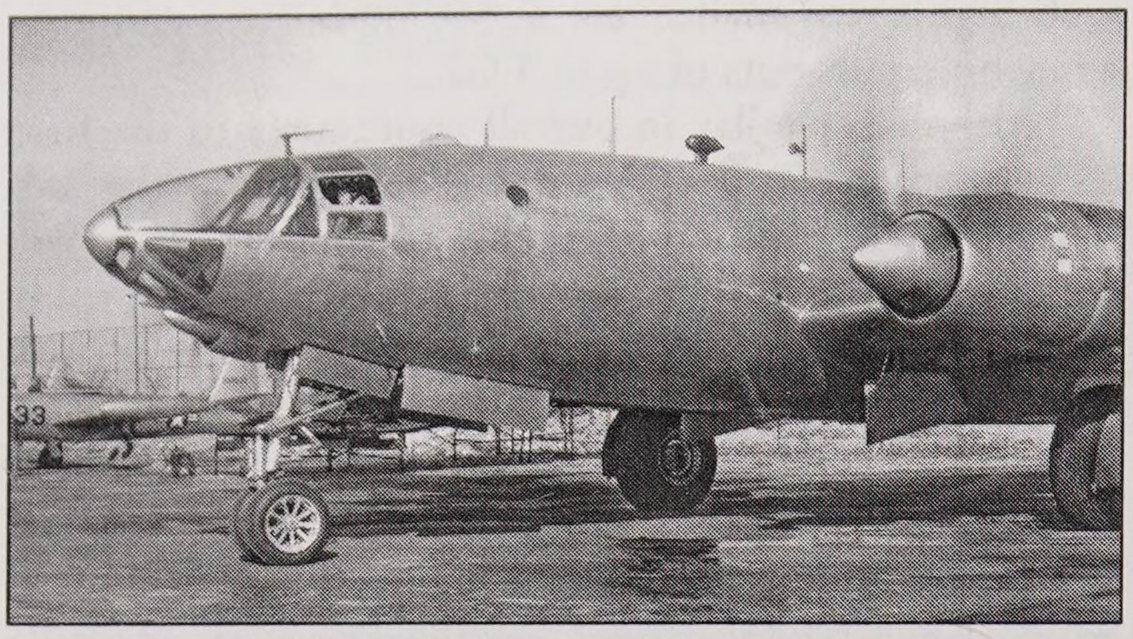
XF-12 Ship Two (S/N 44-91003) made its first flight from Republic's airport on 12 August 1947, eighteen months after the first prototype's inaugural flight, and little more than one month before the U.S. Air Force was established as an independent branch of the Armed Forces, as created by the National Security Act of 18 September 1947. Flown by Oscar "Bud" Haas (co-pilot on the first flight of Ship One, and now Republic's new director of flight test), and assisted by co-pilot L. R. "Pete" Collins and flight engineer James Creamer, Ship Two leaped off the runway at Republic Field, and remained airborne for a flawless test flight that lasted 1 hour and 15 minutes. Upon landing, Haas was quoted as saying the second airplane handled "equal, if not better" than the first prototype. During subsequent testing at Republic, he put the big aircraft through its paces with such high-speed maneuvers as 500-mph dives and gut-wrenching pull-outs of up to 4 Gs.

Although similar in overall appearance to the first XF-12 prototype, Ship Two was identifiable by the lack of the stylized blue italic "Republic Rainbow" logotype seen just below the cockpit windows of the first prototype. Additionally, three sets of triple-louvered engine-cooling "extractor gills" were installed on the outboard upper halves of each engine nacelle. Other external differences included the installation of a "rams-horn" UHF antenna mounted directly above the cockpit windows, which was later retrofitted to the first XF-12. Finally, the aircraft's tail number "491003" was placed slightly higher on the vertical fin than the tail number "491002" on the first airplane. External dimensions of both prototypes were identical.

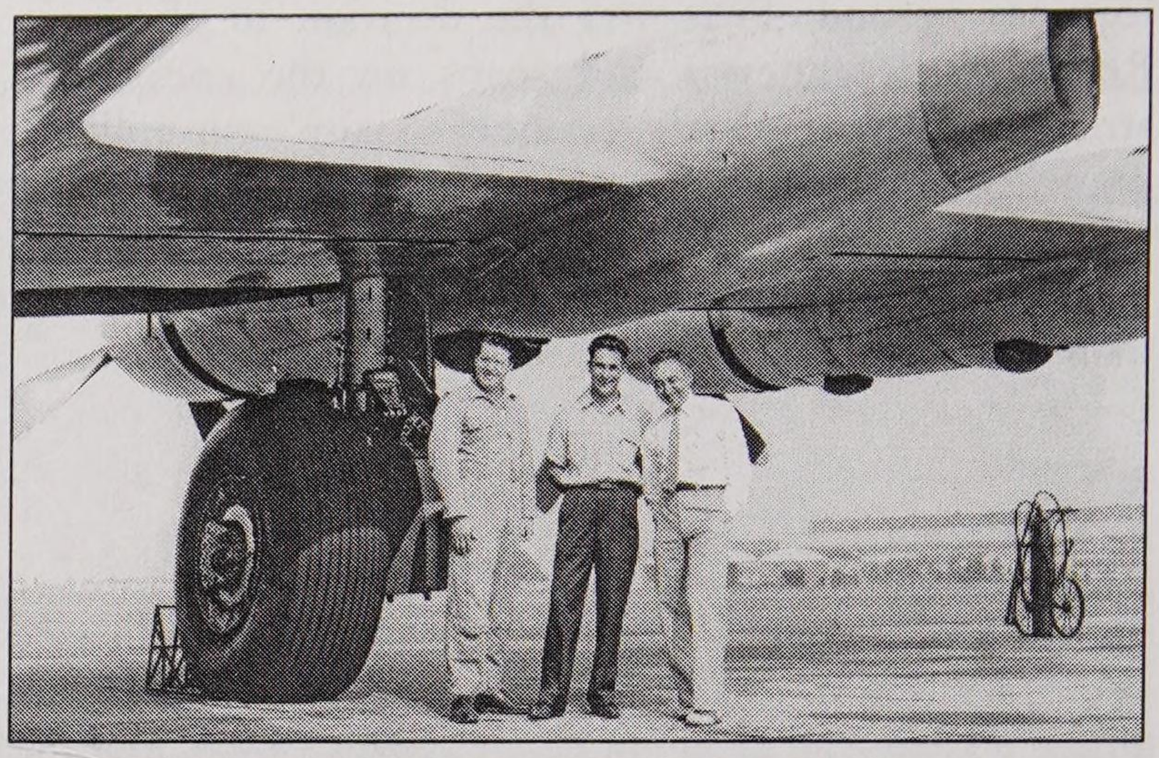
After initial airworthiness and performance evaluations were completed by Republic flight crews, XF-12 Ship Two was flown from Farmingdale to Wright Field in Dayton, Ohio, with an all–Air Force crew on 4 February 1948—two years to the day after the first airplane flew, and four years to the day after the original XF-12 designation was awarded to Republic by the USAAF. In Dayton, the airplane began its Air Force Phase II performance-and-handling evaluation while Ship One remained at Republic conducting crew familiarization and check flight functions after coming out of repairs following its landing accident. That airplane also underwent continued engineering refinements and improvements that were identified as Ship Two was being put through its test program.



Newly appointed president Mundy I. Peale (right) presents Republic's director of flight operations, Lowery L. Brabham, with his ten-year-service pin in 1949. "Brab" made the inaugural flights of both the XP-47B and the first XF-12. Peale, the former plant manager at Republic's Evansville, Indiana, P-47 facility, quickly rose through the corporate ranks and attained the presidency in 1947. He held that position until Republic's purchase by the Fairchild Hiller Corporation in 1965. (Frank Strnad via Author Collection)

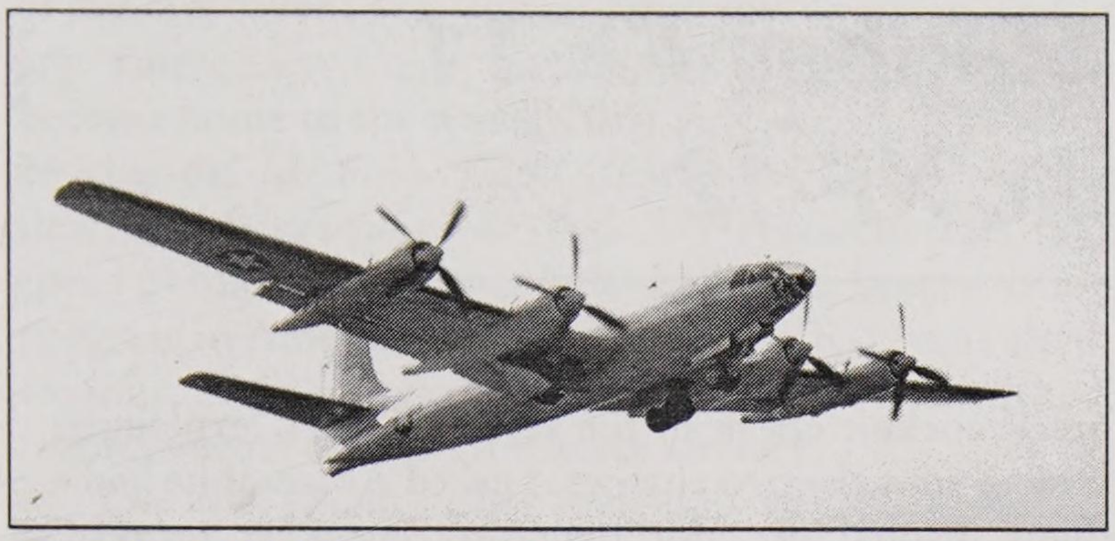


After its rollout in July 1947, XF-12 Ship Two underwent extensive pre-flight testing and checkouts for all onboard systems. Here, the following winter, the ground crew is performing an engine run-up. Note good detail of the engine cowling "gills" seen on the upper halves of each nacelle, a unique and identifiable feature of the second XF-12. (Cradle of Aviation Museum via Dennis R. Jenkins)

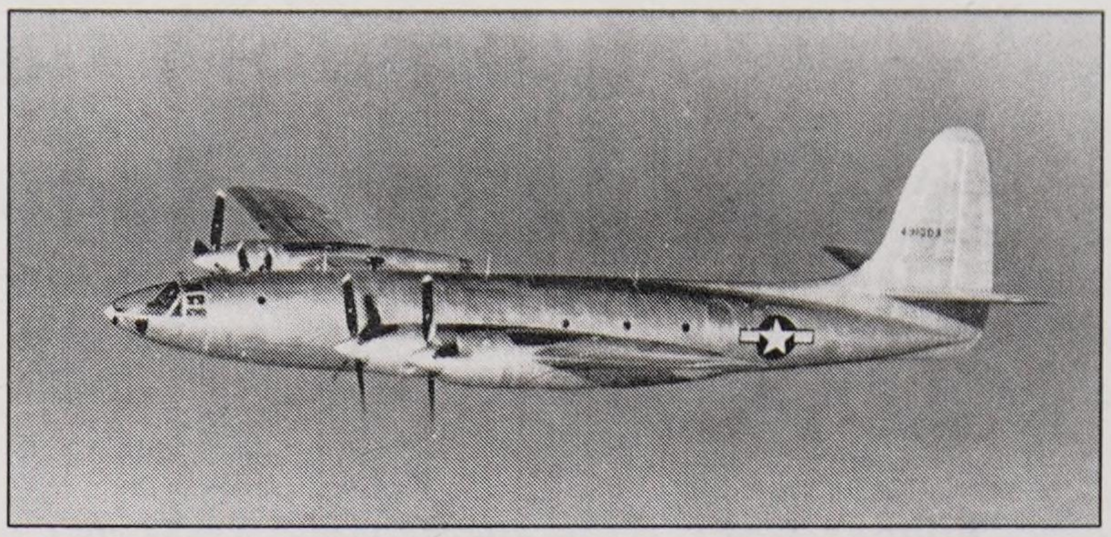


Flight crew for the inaugural flight of Ship Two was: newly promoted director of flight test Oscar P. "Bud" Haas (right), co-pilot L. R. "Pete" Collins (center), and flight test engineer Jim Creamer (left). Note detail of engine nacelles and main landing gear. (Cradle of Aviation Museum via Dennis R. Jenkins)

A proud Republic ground crew poses in front of XF-12 Ship Two (S/N 44-91003). This photo gives excellent detail of the aircraft's cockpit area and forward fuselage. "Ram's horn" VOR antenna above the cockpit was a feature of the second XF-12 from its original manufacture, and was retrofitted to Ship One in late 1947. (Cradle of Aviation Museum via Dennis R. Jenkins)



First flight! With its landing gear retracting into the wells, the second XF-12 takes to the skies on 12 August 1947. After completing a successful one-hour 15-minute inaugural test flight, aircraft commander "Bud" Haas was quoted as saying that the second XF-12 prototype handled even better than the first. (Cradle of Aviation Museum via Dennis R. Jenkins)

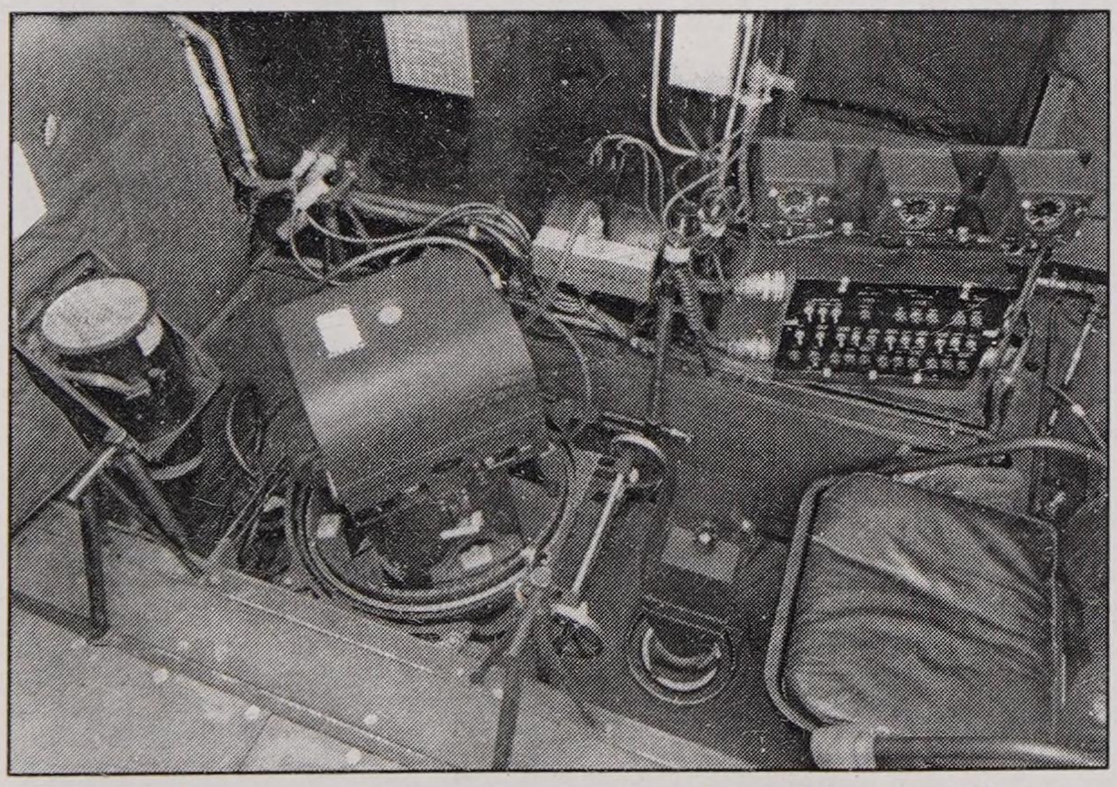


Extremely rare photograph of Ship two in flight at dusk. Aircraft registration number "491003" was placed slightly higher on the vertical stabilizer than the tail number on Ship One, and the aircraft had no "Republic Rainbow" logotype painted below the cockpit windows. (Cradle of Aviation Museum via Dennis R. Jenkins)

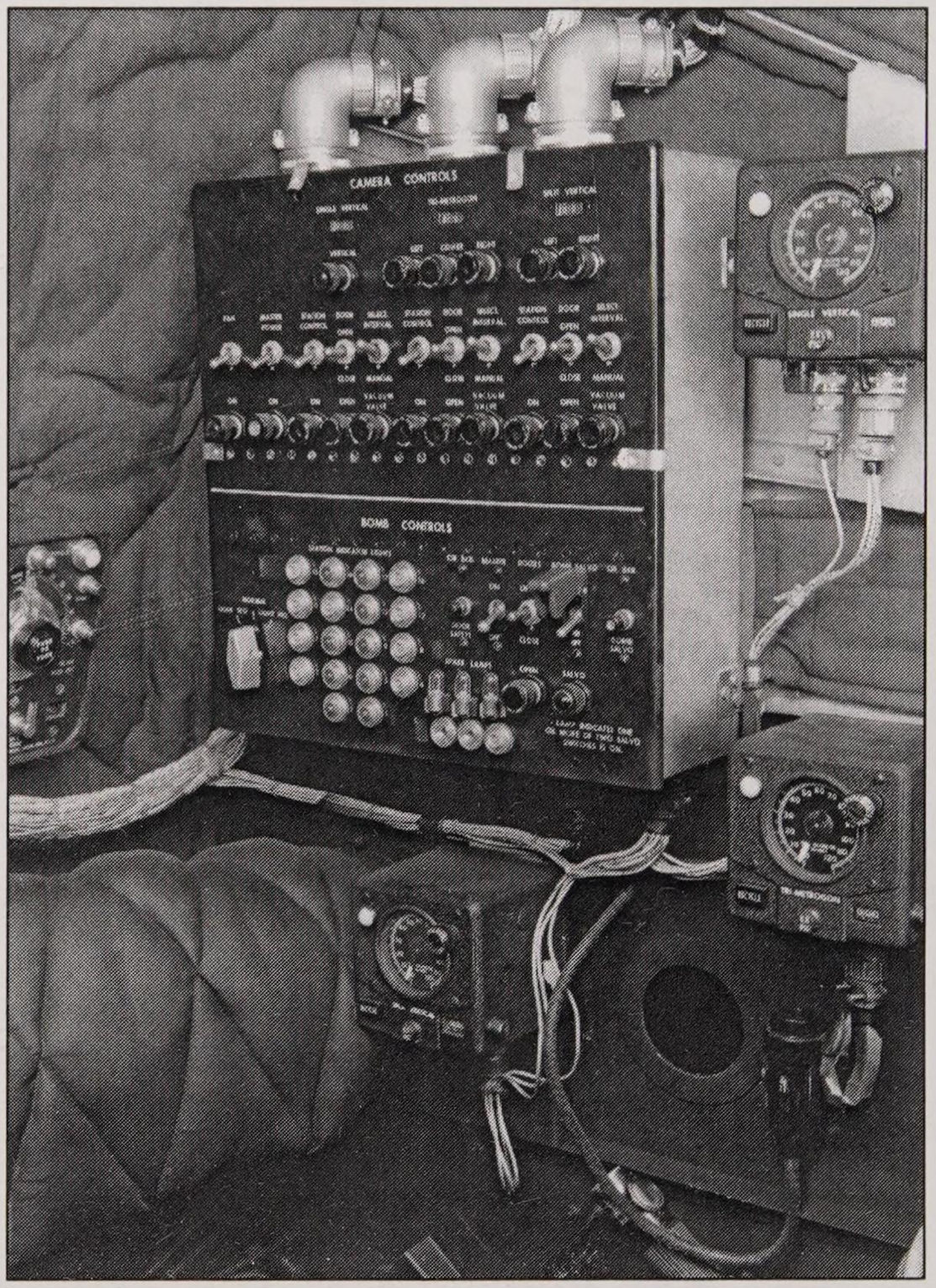
Coast-to-Coast Portrait of America

Operation Birds-Eye was conceived as the ultimate demonstration of the XF-12's inflight high-altitude photo capability. With Ship Two completely outfitted as the flying embodiment of Col. Elliott Roosevelt's original October 1943 proposal, the newly established U.S. Air Force was not about to waste an opportunity to show the world its latest photo-recon airplane. During the last week of August 1948, the Republic's second prototype, newly designated as the XR-12, was flown westward from Wright Field to the Air Force Flight Test Center at Muroc, California, soon to be known as Edwards Air Force Base.

About a two-hour drive northeast of Los Angeles, this remote desert test site afforded the utmost in a dedicated flight test environment with wide-open skies above the Mojave Desert, and the safe haven of 13 miles



Here is the camera operator's station showing the single vertical camera housed on its rotating mount. Operator's optical viewfinder with four-piece glare shield is visible just forward of the seat. (Cradle of Aviation Museum via Dennis R. Jenkins)



Close-up of camera and flash bomb control panel on right-hand aft bulkhead at the navigator/photographer station. This crewmember was located next to the flight engineer in the forward fuselage. The three square devices with round gauges at upper right, center right, and underneath the control panel are Fairchild-built intervalometers that control the number of exposures per minute taken by each camera station in the aft fuselage. Three-digit photo counters can be seen at lower right of each unit. (Cradle of Aviation Museum via Dennis R. Jenkins)

Flying Both the Hughes XF-11 and Republic XF-12

By George Marrett

Editor's Note: *Flying the Republic XF-12 was a rare experience for any Army Air Forces test pilot in 1947, and flying the competing Hughes XF-11 was an even more rare experience. There were only a privileged few Air Force pilots who ever flew* both *airplanes, and one of them was Major General Fred J. Ascani, then–chief of the Bomber Test Section of the exalted Fight Test Division at Wright Field in Dayton, Ohio. A graduate of West Point, Ascani later became the first vice commander of the new Air Force Flight Test Center at Edwards AFB, California, and retired in 1975 as a senior staff officer at the Pentagon. Sadly, he passed away at the age of 92 as this book was being written. The following is General Ascani's recollection of flying both the XF-11 and XF-12, via noted author and former USAF test pilot, George Marrett.*

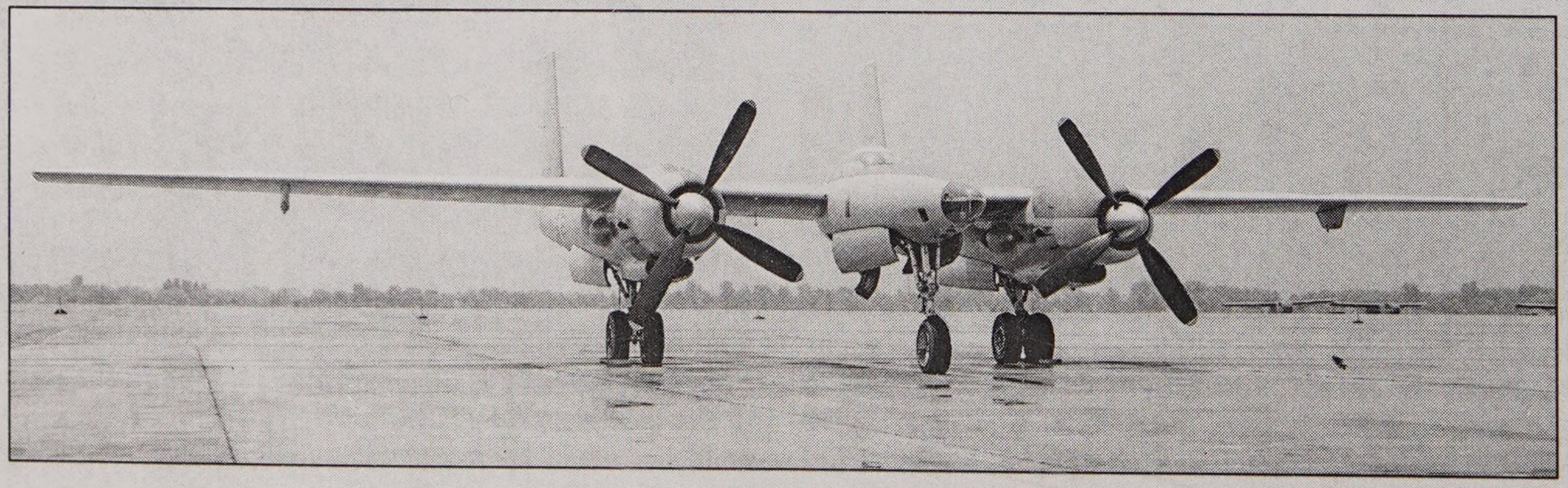
"The Hughes XF-11 did a beautiful job of putting the pilot at ease," said retired Air Force Major General Fred J. Ascani. "For a test pilot, flying the ship was a wonderful experience." During World War II, Ascani had flown a total of 53 combat missions in the B-17, and was assigned to the Air Technical Command's Flight Test Division at Wright Field in 1944. He became executive officer to Colonel Albert G. Boyd, famed commander of the Flight Test Division, and "father of modern flight test" who later ran Edwards AFB, home of the legendary X-Planes during the late 1940s and early 1950s.

The XF-11 that Ascani flew was the second prototype, which sported single four-blade propellers on each engine rather than the complex counter-rotating propellers that were the prime causal factor in the first prototype's crash. Major Russ Schleeh gave Ascani a quick cockpit check in the second XF-11, explaining how to start the two engines. I asked Ascani if he had a flight manual or pilot operating checklist to read. "Hell, no!" said Ascani. "Russ just said, 'Here's the throttles; here's how to start them. Find the brakes on your own.'"

By this time in his flying career, Ascani had flown many kinds of aircraft, and had developed a standard routine for making his test pilot observations. He took off on the west runway at Wright Field and climbed to 10,000 feet over Xenia, Ohio. Slowly, he banked the twin-engine XF-11 into a 45-degree turn and increased the Gs. He steepened the bank angle to 60 degrees to evaluate the turning performance. Then he repeated the same test to the right. Next, he rolled the airplane back to level flight and kicked the rudders back and forth to determine the inherent directional stability of the twin-boom aircraft.

"My biggest surprise," said Ascani, "was how easily the XF-11 flew." He then extended the gear and flaps, pulled the power back on both engines, and slowed down for an approach to the stall. Both the landing gear and flaps were then retracted as he continued to increase back pressure on the yoke. Gradually the speed bled off until he felt a nibble at around 140 to 145 knots. He felt it was wise to avoid a full-blown stall in an aircraft he had only flown for a few minutes, however. After the approach to the stall, Ascani descended and entered the traffic pattern at Wright Field to perform two touch-and-goes before making a full-stop landing. He then logged the 30 minutes of flight time in his Form 5 (a military logbook).

I asked the General why he flew the XF-11. "To get as many different aircraft listed in my logbook," replied Ascani. "The more varied flying time, the better flight test programs would be offered to me."



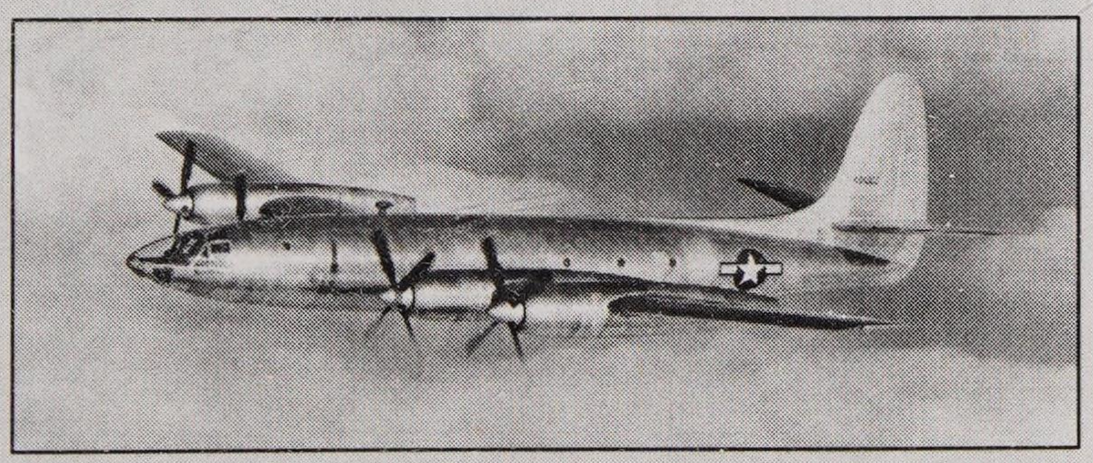
of flat, dry lakebed to land on from any direction, and in any emergency. Only ten months earlier, Muroc had become home to the world's first supersonic flight when 26-year-old Air Force Capt. Charles E. "Chuck" Yeager flew the rocket-powered Bell X-1 research craft to a speed of Mach 1.06. It was indeed a time of great aviation progress in America, and the Republic XR-12 was about to join the very exclusive club of Muroc-launched, record-setting high-performance aircraft.

On the bright, clear morning of Wednesday, 1 September, the second XR-12 departed Muroc's Runway 24 at 11:41 am and climbed westward toward the placid waters of the Pacific Ocean. Piloted by aircraft commander Capt. William W. "Bill" Elliot and co-pilot/navigator Maj. Delbert Clark, the airplane began a gentle 180-degree left turn, climbing at 2,000 feet per minute and reaching its operational cruising altitude of 40,000 feet in 20 minutes. Back in the aircraft's capacious cabin, photo system technicians MSgt. Willard Shaw, MSgt. Jack Sowers, and TSgt. Richard Wing prepared the Fairchild K-17 trimetrogon camera system for its upcoming claim to fame. Now established on course and passing east/northeastward over the picturesque coastal town of Ventura, the XR-12's cameras started rolling at 12:00 noon to produce what would become the world's longest continuous strip photograph ever taken. The subject was nothing less than a 490-mile-wide swath of the entire United States as seen from coast to coast.

Thankfully, the weather enroute that day was amazingly clear, with light cloud cover obscuring very little ground under the XR-12's flight path. Specific subject matter seen in the visual strip of transcontinental photographs included the scenic California coastline, the vast Rosamond and Rogers Dry Lakes near Muroc, the engineering wonder of the Hoover Dam near Las Vegas, the Grand Canyon, the serpentine path of the Mississippi River, strip coal mines west of Pittsburgh, and the sharply defined ridges of the Allegheny Mountains.

The second experimental prototype photo-recon airplane flown by Ascani was the beautiful Republic XF-12 Rainbow. Larger, faster, and with a far greater payload than the Hughes XF-11, it was referred to at Wright Field as an airplane that was "flying on all fours," meaning: four engines, 400-mph cruise, and a 4,000-mile range at 40,000 feet. Military test pilots admired its ultra-modern and highly streamlined looks, both in the air and on the ground.

Fred Ascani was on an inspection trip to the Republic plant in Farmingdale, Long Island, when he met Lowery Brahbam, Republic's director of flight operations. With Brahbam acting as both his co-pilot and instructor, Ascani took off in the XF-12 from Republic Field, crossed the Great South Bay and then climbed to 15,000 feet over the Atlantic Ocean. The aircraft was quite light in weight that day, with only a partial fuel load and just one other crewmember sitting at the flight engineer's station. Ascani said the Rainbow had an excellent rate-of-climb—even better than the bombers he was currently testing at Wright Field at the time.



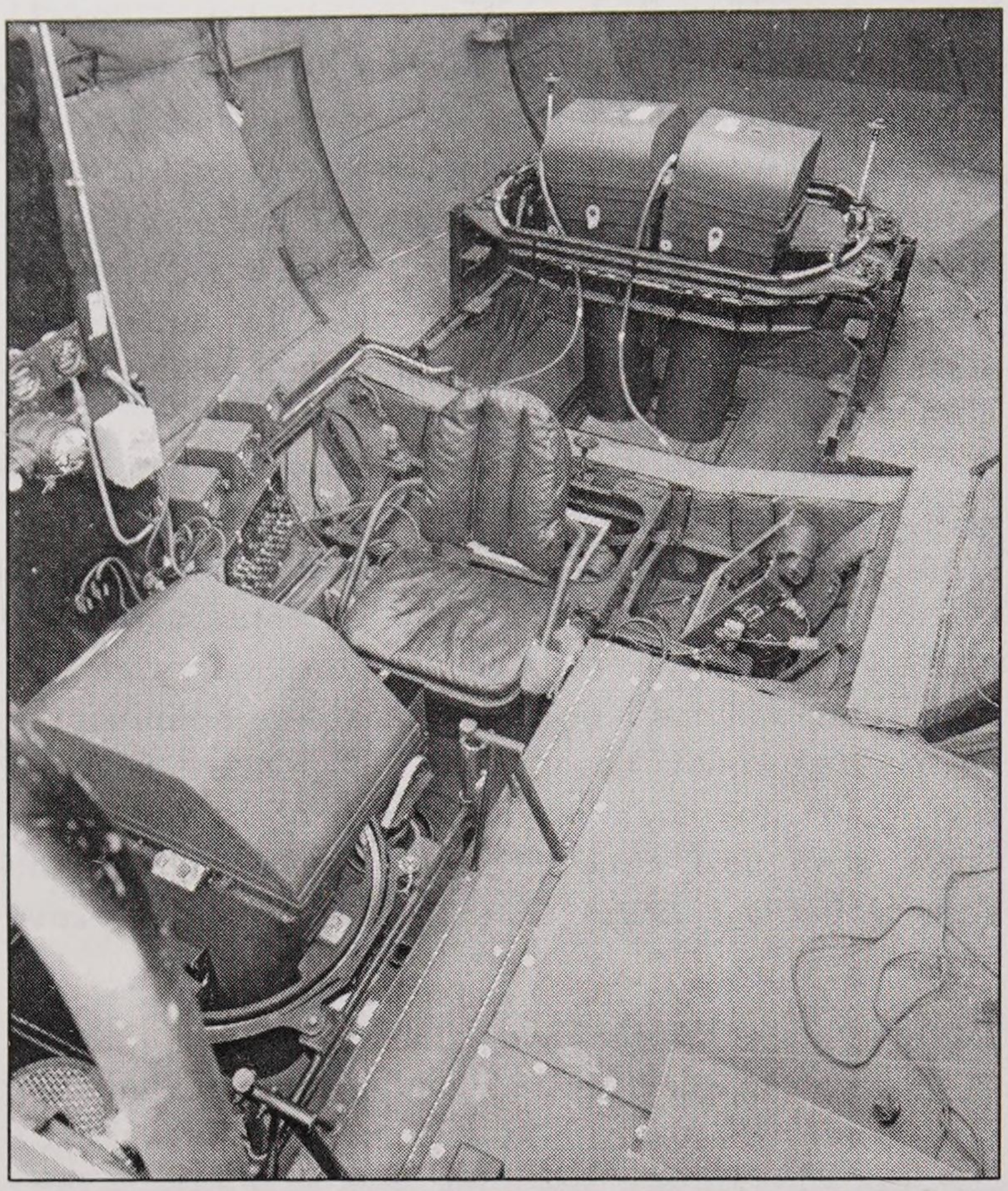
Facing page: ***Hughes XF-11 Ship Two poses on the ramp at Eglin AFB, Florida, in 1948, where it underwent the final test phase of its short Air Force career.*** **Above:** ***Republic XR-12 Ship One inflight over Long Island in 1946.*** (Photo Facing Page: Courtesy of Craig Kaston; Photo this Page: via Author Collection)

As he had done in the XF-11, Ascani banked the XF-12 into steep turns both left and right to evaluate the aircraft's control harmony and handling in the turns. Back in straight-and-level flight, he kicked the rudder pedals to pulse the massive rudder, and timed the resulting oscillations to determine the aircraft's inherent directional stability. The two outstanding features of the XF-12 that Ascani recalls are the great visibility from the side-by-side cockpit and the extremely quiet engines. He'd flown many hours in the much noisier Boeing B-29, and was very impressed with the Rainbow by comparison, for its Pratt & Whitney R-4360 engines, despite having a third more power than the B-29's Wright R-3350s, were so quiet he could hardly hear them from the cockpit.

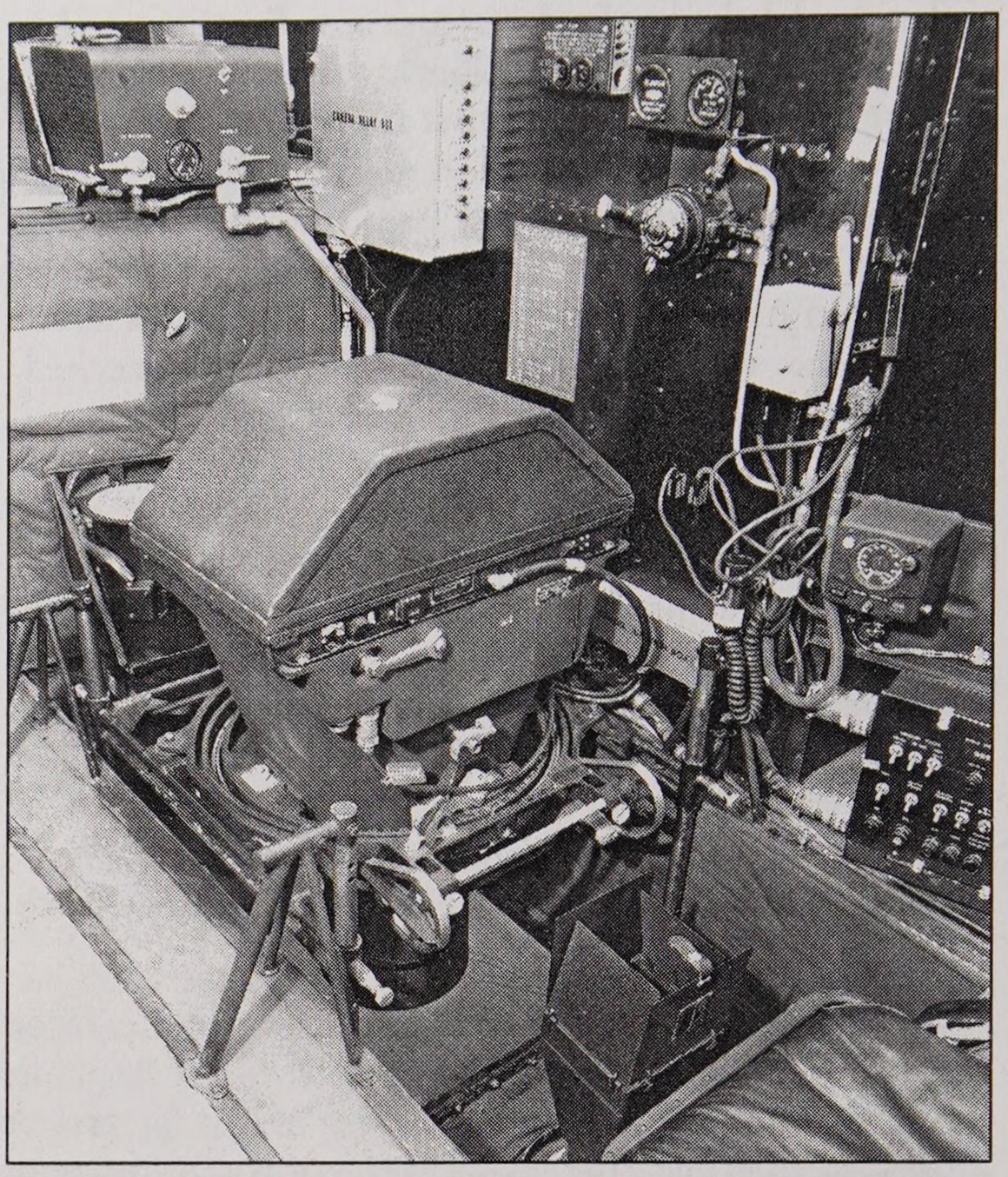
After about 40 minutes cavorting through the clear blue skies south of Long Island, Ascani descended back into the pattern at Republic's private airport, and then made two touch-and-goes on Runway one-four before returning the airplane to the ramp. The excellent visibility through the XF-12's torpedo-shaped glass nose allowed him to make glassy-smooth landings every time.

I asked General Ascani to compare the Hughes XF-11 to the Republic XF-12. He stated, "Although both aircraft were designed for the same mission, each was quite different. Both were excellent aircraft," he continued, "and I was saddened the Army canceled the reconnaissance contract, and that neither plane went into production."

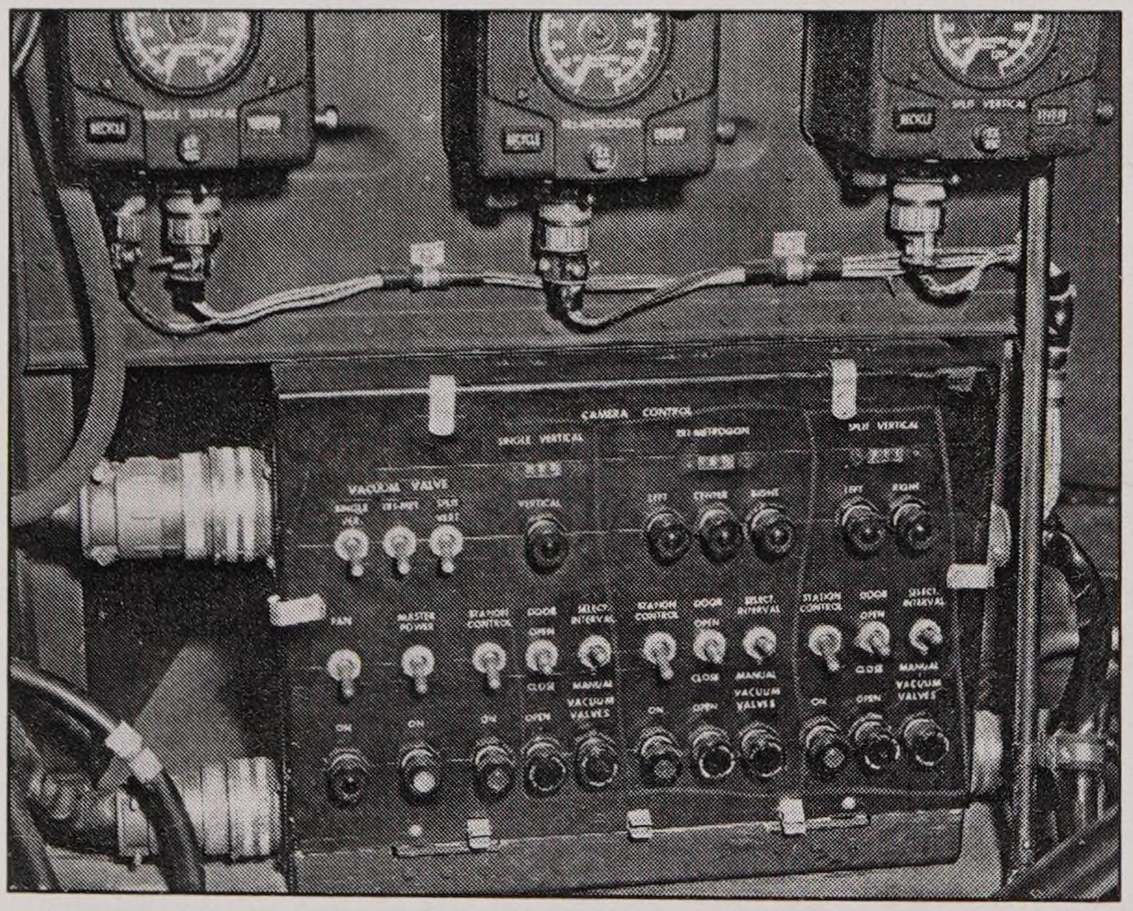
Few pilots ever got to fly either the ultra-rare Hughes XF-11 or the ultra-sleek Republic XF-12. Fred Ascani flew them both, experiencing a true test pilot's dream, and making two very real flights into the future.



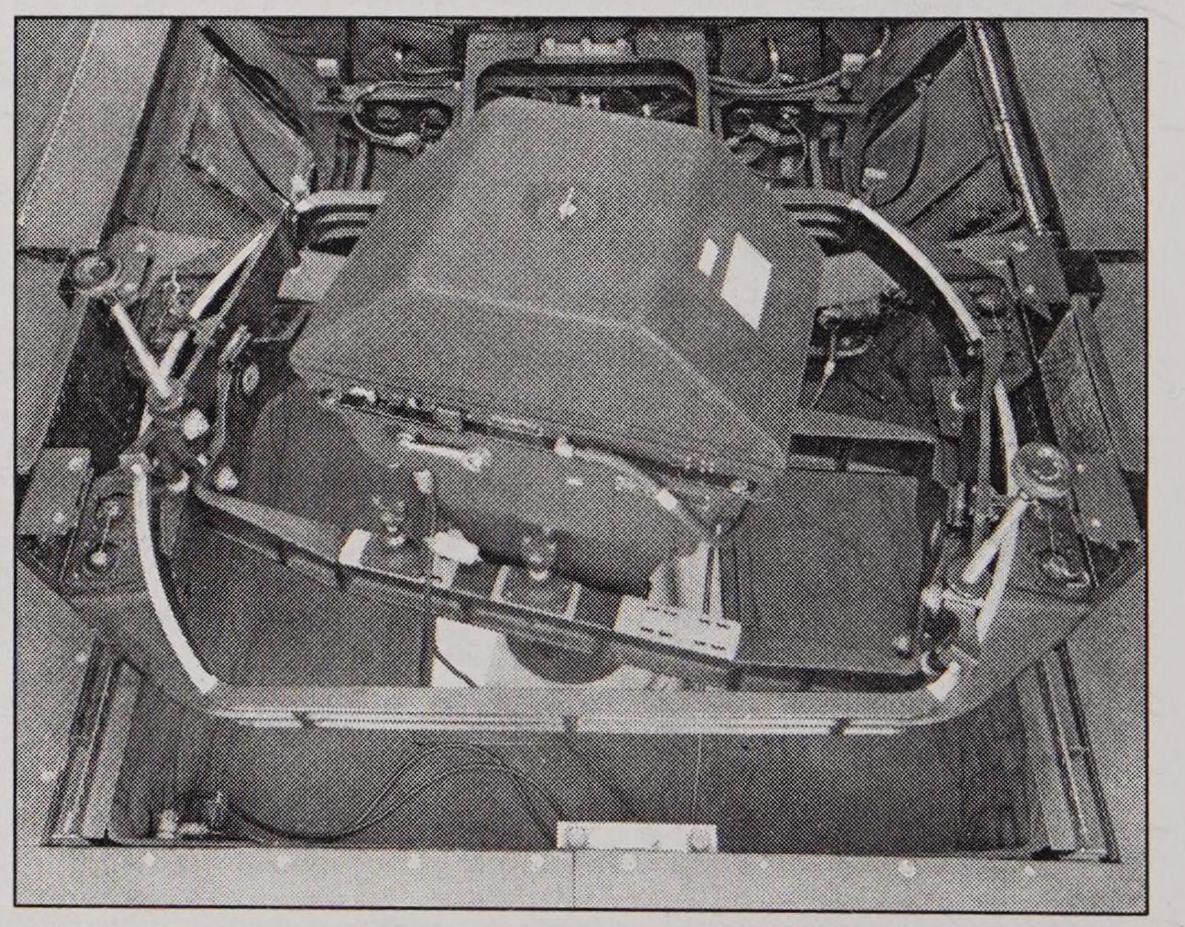
Looking aft from the mid-fuselage, we see the camera operator's station at center of photo, with a single vertical camera in the foreground, the three-camera trimetrogon system immediately aft of the operator's seat, and the split vertical camera system at upper right. Aircraft's main boarding door would be at extreme upper right of photo. (Cradle of Aviation Museum via Dennis R. Jenkins)



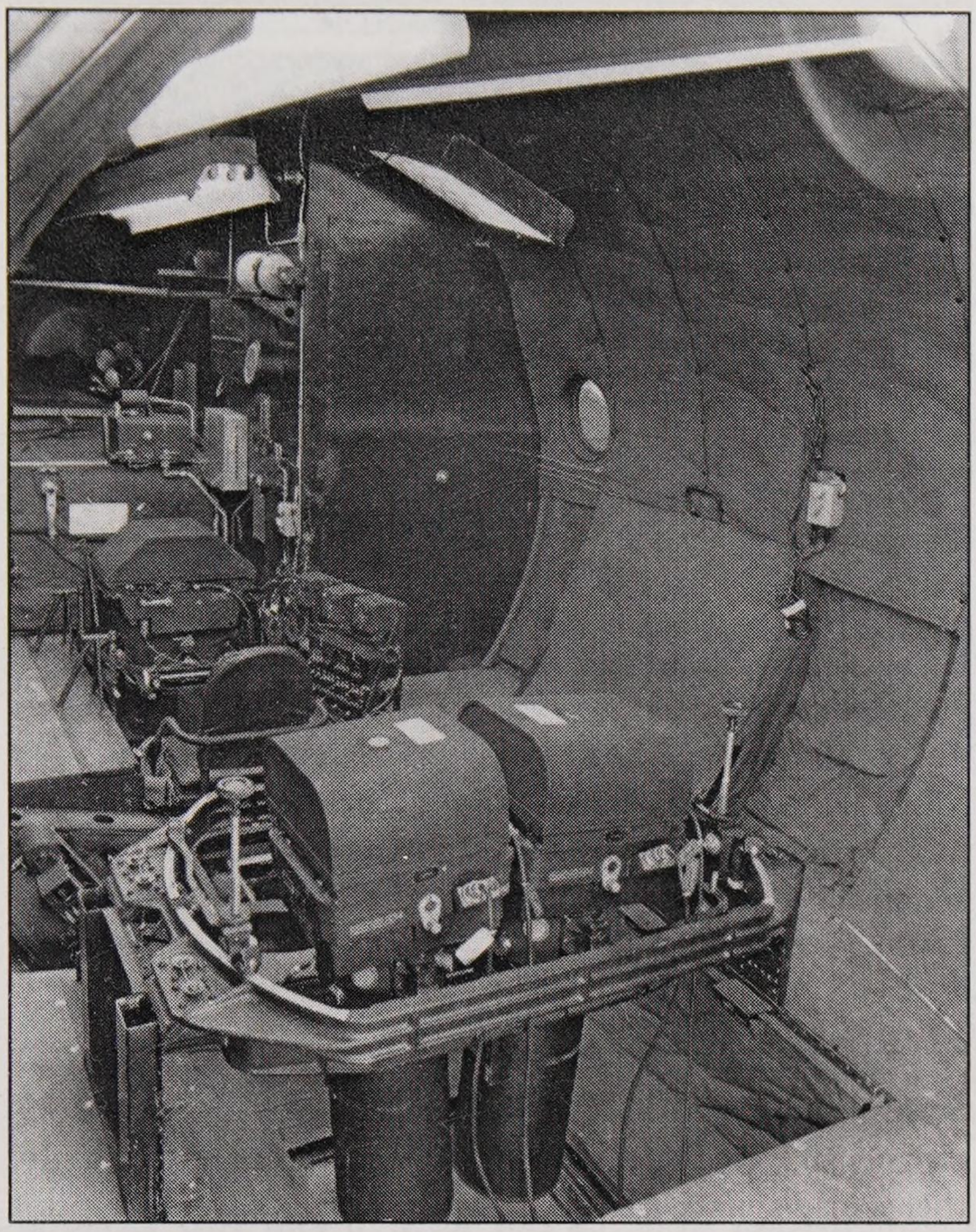
Single Fairchild K-18 vertical camera is shown in its rotating mount fitted with a 24-inch focal-length lens. This workhorse camera was developed primarily for high-altitude photography and could be operated either manually or with an intervalometer, which automatically triggered the camera at a pre-set timing sequence. This is the forward camera position. (Cradle of Aviation Museum via Dennis R. Jenkins)



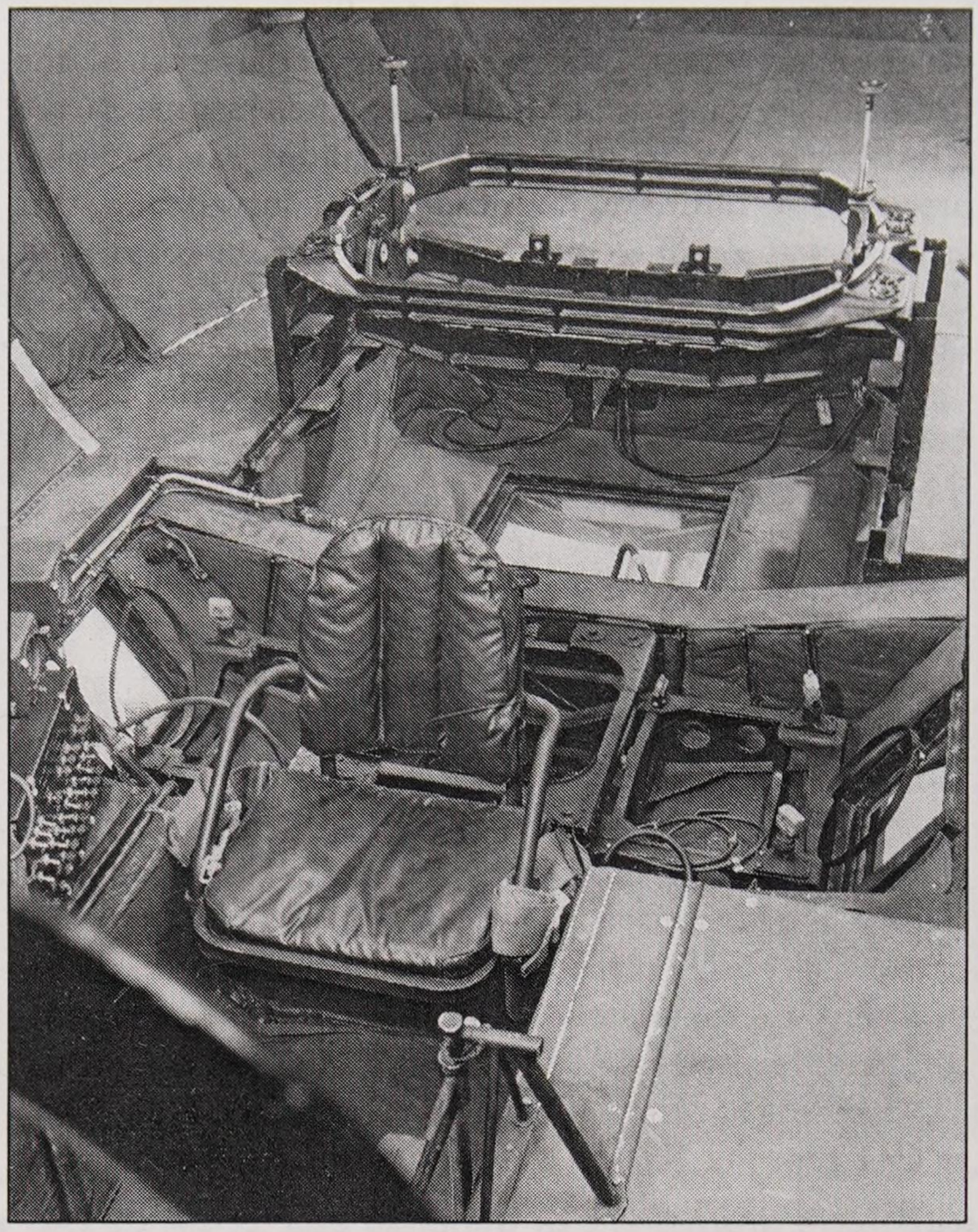
Close-up of camera operator's clean and well-laid-out photo systems control panel, which is duplicated at the navigator's station in the forward fuselage. The aircraft navigator performed the critical function of making sure the airplane arrived at the precise position identified as the subject area for its photo reconnaissance on each mission. (Cradle of Aviation Museum via Dennis R. Jenkins)



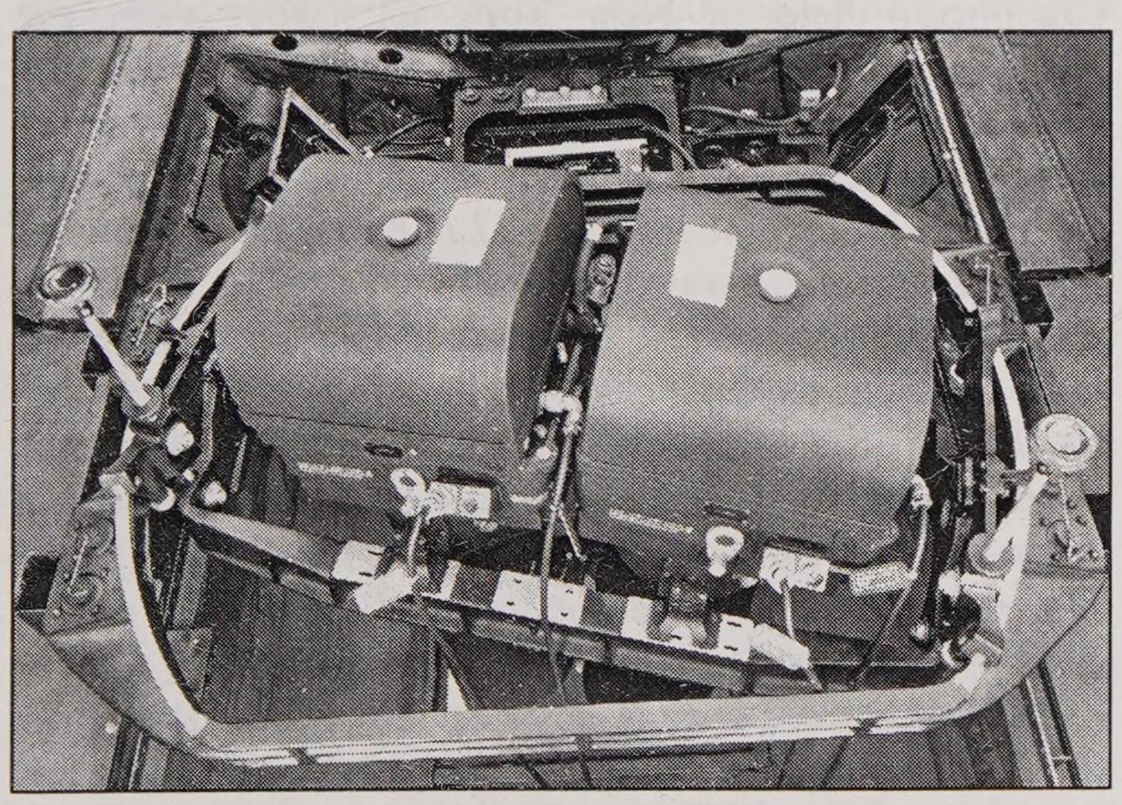
View looking down into the XF-12's rearward-most camera station, showing a single Fairchild K-18 camera slightly rotated in the much larger mount. This camera station was normally occupied by twin Fairchild K-22 cameras set up as a split vertical system for stereoscopic photography that created an almost three-dimensional image for the viewer. (Cradle of Aviation Museum via Dennis R. Jenkins)



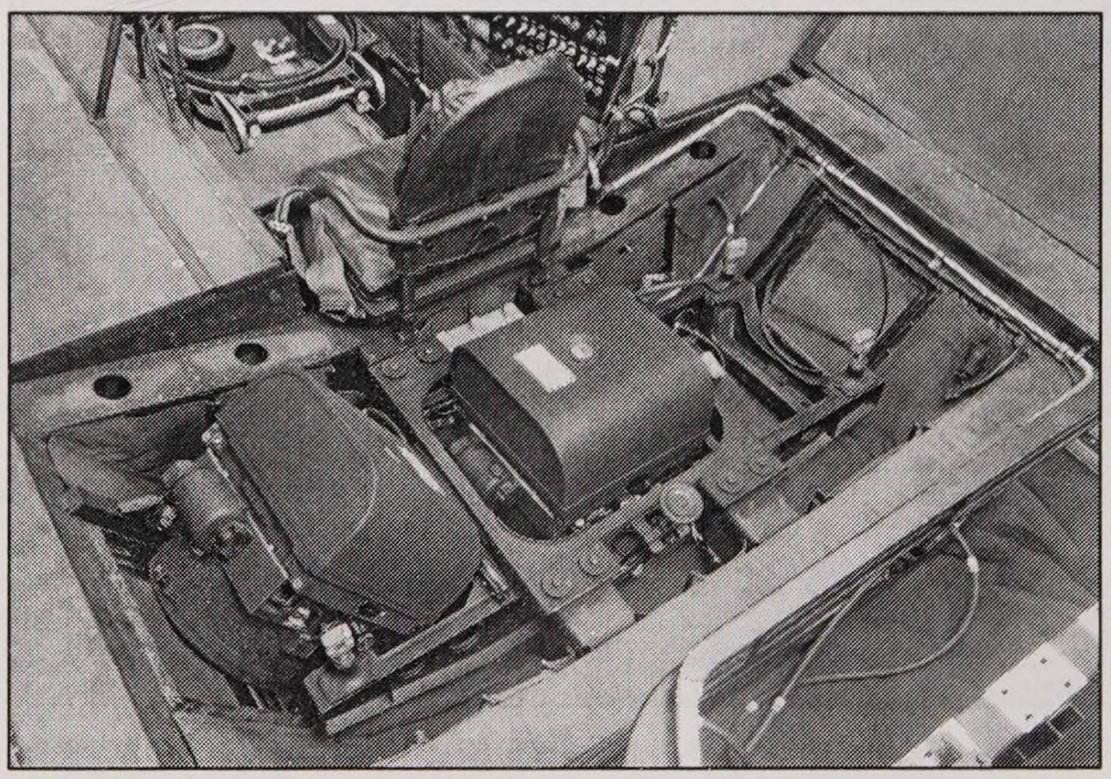
Here is the mount with standard twin Fairchild K-22 high-altitude day-reconnaissance cameras fitted with 40-inch telephoto lenses. Capable of shutter speeds of up to 1/800 second, this camera system could take up to 200 exposures at a rate of one photo every three seconds. View is looking forward, and black walled-in area at upper center is the XF-12's novel onboard dark-room for film storage and immediate processing of film in flight. (Cradle of Aviation Museum via Dennis R. Jenkins)



View looking aft from the camera operator's station, showing empty trimetrogon camera bay aft of his seat, and the empty split vertical camera housing behind that. All camera windows were electrically heated in flight. (Cradle of Aviation Museum via Dennis R. Jenkins)



Twin Fairchild K-22 split vertical camera system is shown rotated slightly in its mount. These cameras used Eastman Kodak Aero Ektar lenses with focal-plane shutters. Rolls of film for these devices measured 9.5 inches wide by 390 feet long, while image size for each photo was 9 x 9 inches. (Cradle of Aviation Museum via Dennis R. Jenkins)

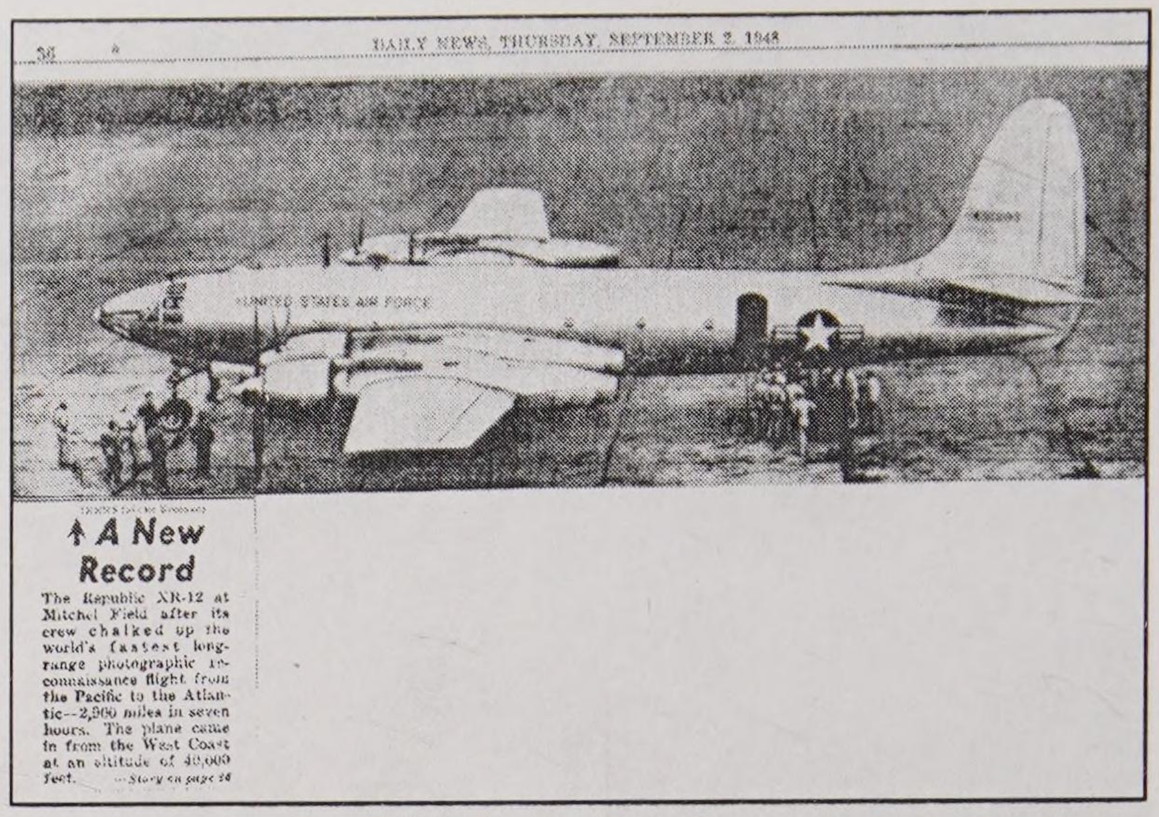


The XF-12's trimetrogon camera system is shown here with two of the three Fairchild K-17 cameras placed in their mounts. These cameras, fitted with 6-inch lenses, are capable of shutter speeds up to 1/300 second. The K-17 was an excellent all-purpose camera used for photo mapping, aerial reconnaissance, intelligence gathering, and bomb damage assessment. The three-camera trimetrogon system essentially provides a wide-angle or panoramic view of the area being photographed. (Cradle of Aviation Museum via Dennis R. Jenkins)

Serving as a fitting finale to this collection of dramatic geographical images was a stunning aerial view of the towering skyscrapers of Manhattan, taken just before the XR-12 began its initial descent for landing. In a graphic precursor to future high-altitude aerial surveillance, this airplane was about to give the world a sneak-preview of the images we take for granted today with 24-hour access to high-definition Google Earth aerial views available on our home computers and hand-held digital devices. In 1948, however, this was as good as it was going to get for the American public.

Composed of 390 individual trimetrogon photographs taken once every 66 seconds throughout the flight, the single continuous filmstrip measured 325 feet from end to end, two-dozen feet longer than a football field. Covering 2,700 miles at an average speed of 375 mph, the XR-12 had maintained its 40,000-foot service ceiling for all but the first and last 50 miles of the flight, and made the nonstop transcontinental journey in an elapsed time of only 6 hours and 55 minutes. (By comparison, a routine transcontinental airline trip that same year took approximately 10 hours and included a mandatory stop for fuel somewhere in the Midwest.)

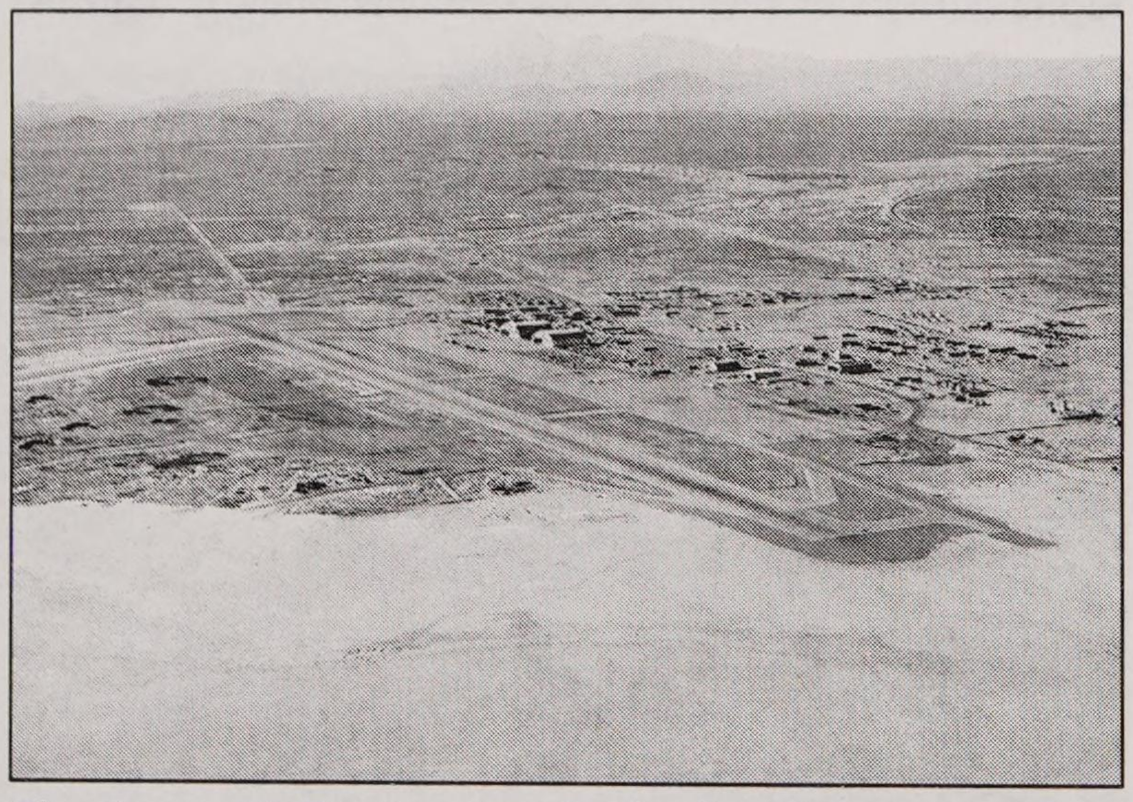
Landing at Mitchel Field in Garden City, New York, at 6:41 pm, the XR-12 was parked on a ramp that had plenty of history of its own. Mitchel Field, built in 1917 and named for former New York Mayor John P. Mitchel who was killed in a training accident during World War I (and not Gen. Billy Mitchell as is commonly written in error), was one of the largest training bases in the United States during World War I. Mitchel test units also conducted aircraft flight instrument development. Fittingly, the world's first "blind" flight with Army test pilot Jimmy Doolittle piloting an airplane from takeoff to landing totally on instruments was accomplished there in 1929. In March 1946, the Air Defense Command was created and headquartered at Mitchel, which was located immediately southeast of neighboring Roosevelt Field, the historic ground from which Charles Lindbergh had taken off for his epic New York–to–Paris flight less than 20 years earlier.


36 DAILY NEWS, THURSDAY, SEPTEMBER 2, 1948

↑ A New Record

The Republic XR-12 at Mitchel Field after its crew chalked up the world's fastest long-range photographic reconnaissance flight from the Pacific to the Atlantic—2,900 miles in seven hours. The plane came in from the West Coast at an altitude of 40,000 feet. —Story on page 56

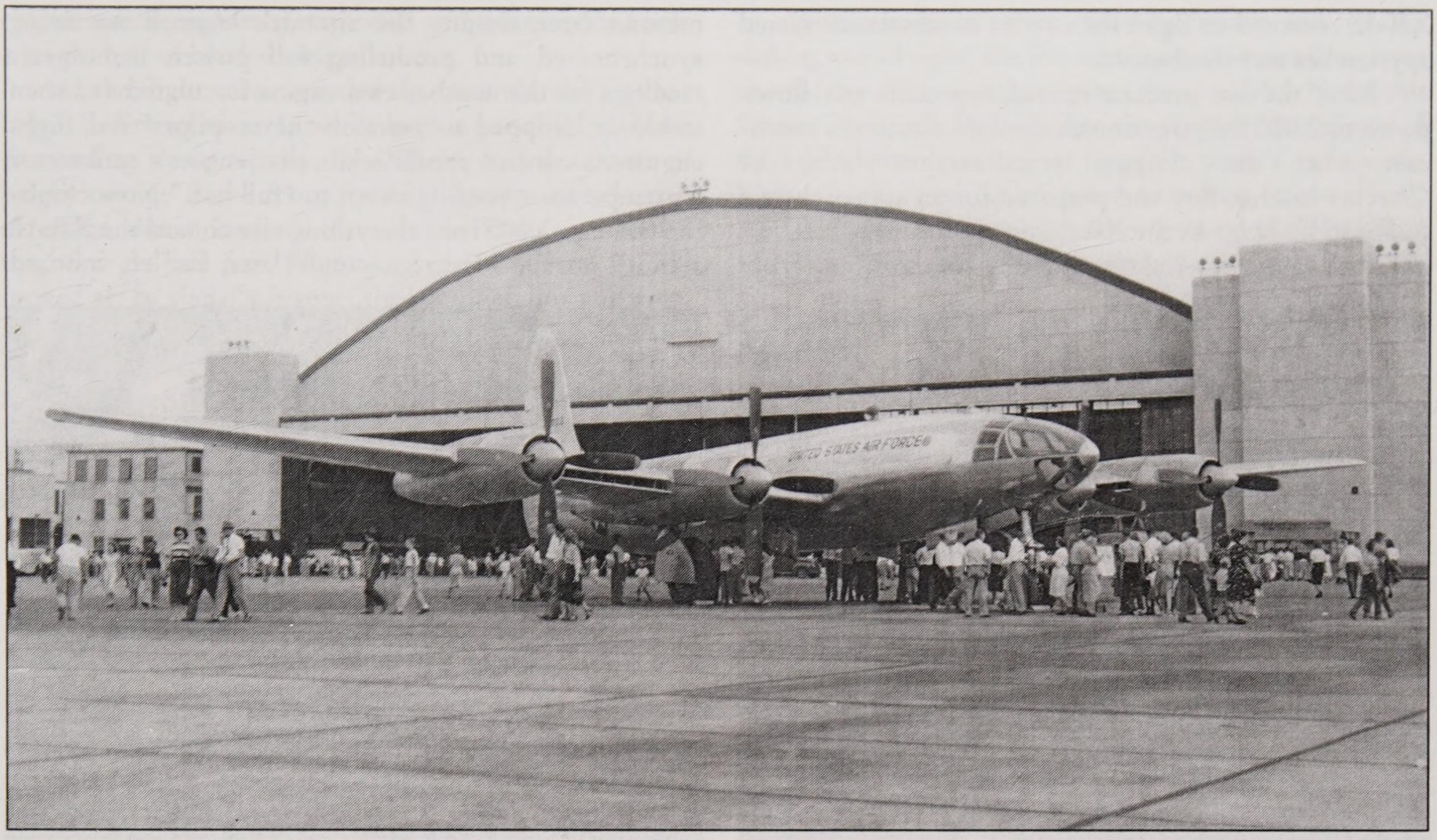
Newspaper clipping from the New York Daily News ***dated Thursday, 2 September 1948, covers the second XF-12's transcontinental flight for Operation Birds-Eye. Article shows a photo of the aircraft at New York's Mitchel Field after completing the high-altitude cross-country trek in only seven hours.*** (Cradle of Aviation Museum Archives)



The Army Air Forces test site in the Mojave Desert at Muroc, California, was the launching point for Operation Birds-Eye. View is looking toward the northwest, with Runway 24/06 at center. Renamed Edwards Air Force Base in 1949, this hallowed piece of real estate has been home to man's conquest of the air since World War II. Experimental rocketplanes made the first flights to Mach 1 through 6, and above altitudes of 100,000, 200,000, and 300,000 feet, all landing on Rogers Dry Lake visible at bottom of photo, and taking manned flight from the supersonic age to the space age. (AFFTC History Office)

Featured at the Air Force Association's 1948 annual convention held in New York City that year, the XR-12's record-setting film strip was put on display for all to admire. Adding to the national publicity fervor for this historic aeronautical achievement was a feature article in the 28 November issue of *LIFE* magazine showing selected photos from the flight, as well as what the entire strip of film looked like laid end to end on the asphalt ramp adjacent to Mitchel's flightline.

For all the hoopla associated with this transcontinental flight, there was some unfortunate and sobering news for Air Force personnel expecting to soon take advantage of the advanced operational capabilities of this exciting new airplane. In short, the program had already been canceled and with it, any hope for a long-term production contract, or completion of 20 "R-12A" aircraft awarded to Republic in an interim agreement. Instead, the Air Force had chosen to modify existing Boeing B-50 Superfortress bombers for the high-speed, high-altitude reconnaissance mission, and word of the program cancellation quickly spread through the ranks. Upon hearing the news of the XR-12's demise, General George Goddard, Chief of the Photo Development Lab at



This view gives a good look at the aircraft's integral leading-edge ram air intakes for engine and supercharger cooling. One month after this air show appearance, the second XR-12 was assigned to the 3200th Proof Test Group at Eglin AFB, Florida, for operational photographic field testing. It crashed on only its second test flight at Eglin AFB. Five of the seven crewmembers survived the accident. Note new "UNITED STATES AIR FORCE" title painted on fuselage. (Cradle of Aviation Museum via Dennis R. Jenkins)

Wright Field, was quoted as saying, "We have hung black crepe on all the doors . . ." in symbolic mourning of the now-extinct program. However, there were to be many more data-gathering flights for both XR-12 prototypes, and specifically the more advanced, photo system equipped, Ship Two. Or so it was thought.

Tragedy Over the Gulf

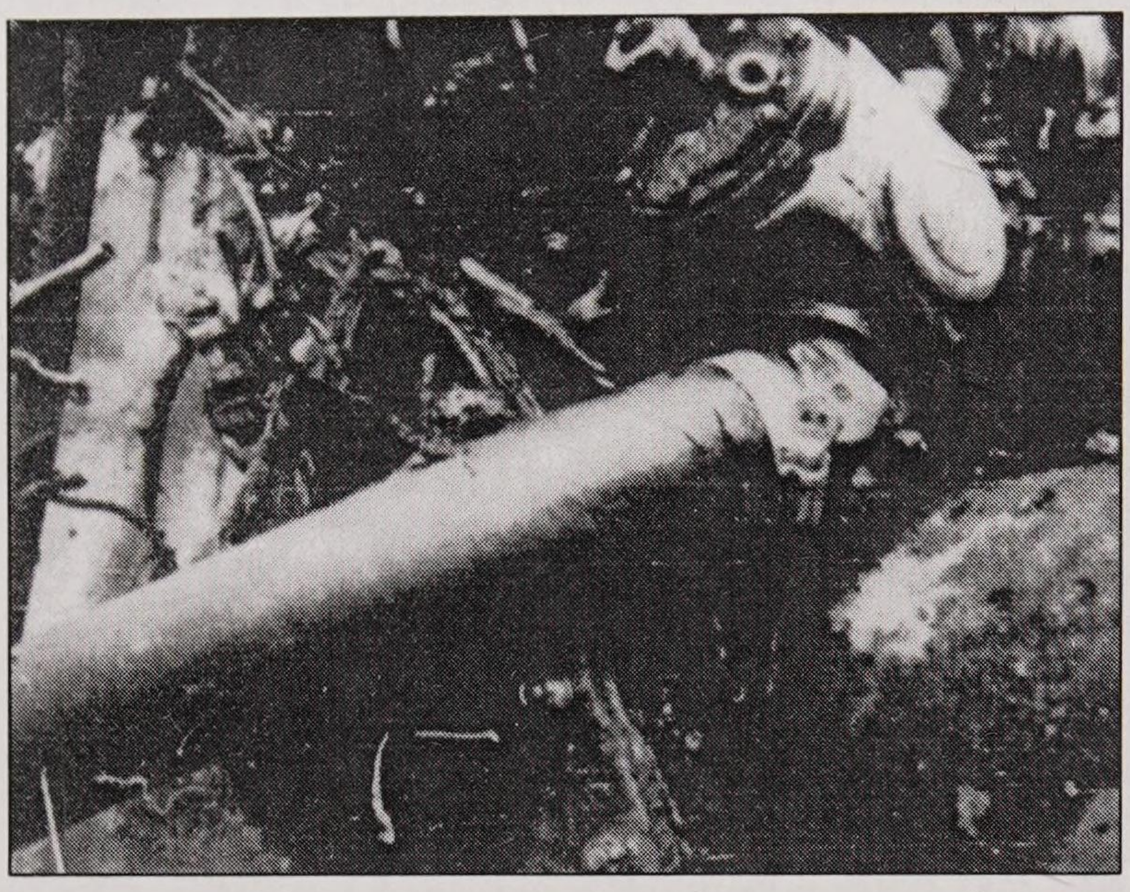
In late October 1948, the second XR-12 was flown from Wright Field to the Air Proving Grounds at Eglin Air Force Base near Fort Walton Beach on the Gulf Coast of Florida's western panhandle. Assigned to the Photo Test Squadron of the 3200th Proof Test Group, the fully equipped airplane was scheduled to undergo a series of special flights for further testing and photographic systems development. Evaluation of the XR-12's onboard photo systems, and resultant information on possible new operating procedures, would also be put to good use in the newly designated Boeing RB-50.

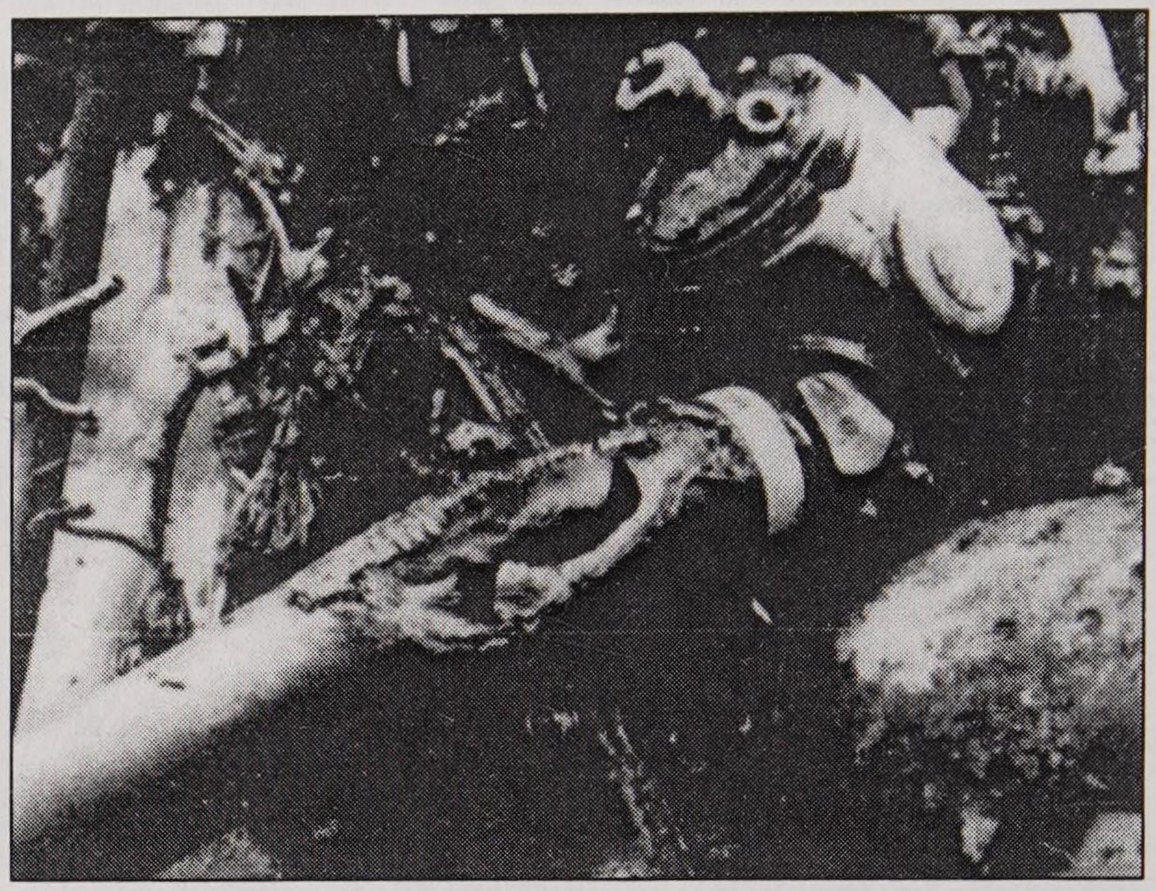
Ship Two's first flight at Eglin took place Thursday, 4 November, and everything was routine. Mission objectives were to check out Air Force pilot Capt. Lindell E. Hendrix, and make a west-to-east photo run across the entire state of Florida at 40,000 feet using the aircraft's split vertical camera system. Hendrix, a former World War II pilot with the 8th Air Force, was Operations Officer for the Test Squadron and had been selected to become Project Officer on the XR-12 test program. By the time the aircraft was airborne, however, typical towering Floridian cumulus clouds had already built up to prevent that part of the mission from being accomplished. The crew decided to use the remaining flight time for general aircraft familiarization and touch-and-go landings which proved to be uneventful.

On Sunday, 7 November, the XR-12's second flight at Eglin also became its last. The airplane had accumulated 116 hours of flying time in little more than fourteen months. With Air Force pilot (and future Republic company test pilot) Capt. Lin Hendrix in the aircraft commander's seat, check pilot and Air Force Capt. Charles W. Morgan flying co-pilot, MSgt. Howard C. Lee as flight engineer, and MSgt. Gerald J. Hosford, Jr. as crew chief, the aircraft departed Eglin's runway at 10:00 am with three photo technicians in the rear cabin: MSgt. Victor C. Riberdy, SSgt. William N. Senole, and Sgt. Vernon B. Palmer. This represented the XR-12's full operational seven-man crew complement. A photo run at 40,000 feet had been scheduled, but this time that part of the mission was aborted due to a malfunctioning turbosupercharger on the number-three engine. After an abbreviated photo run flown at 20,000 feet, the

XR-12 returned to Eglin for a series of simulated missed approaches and climbouts.

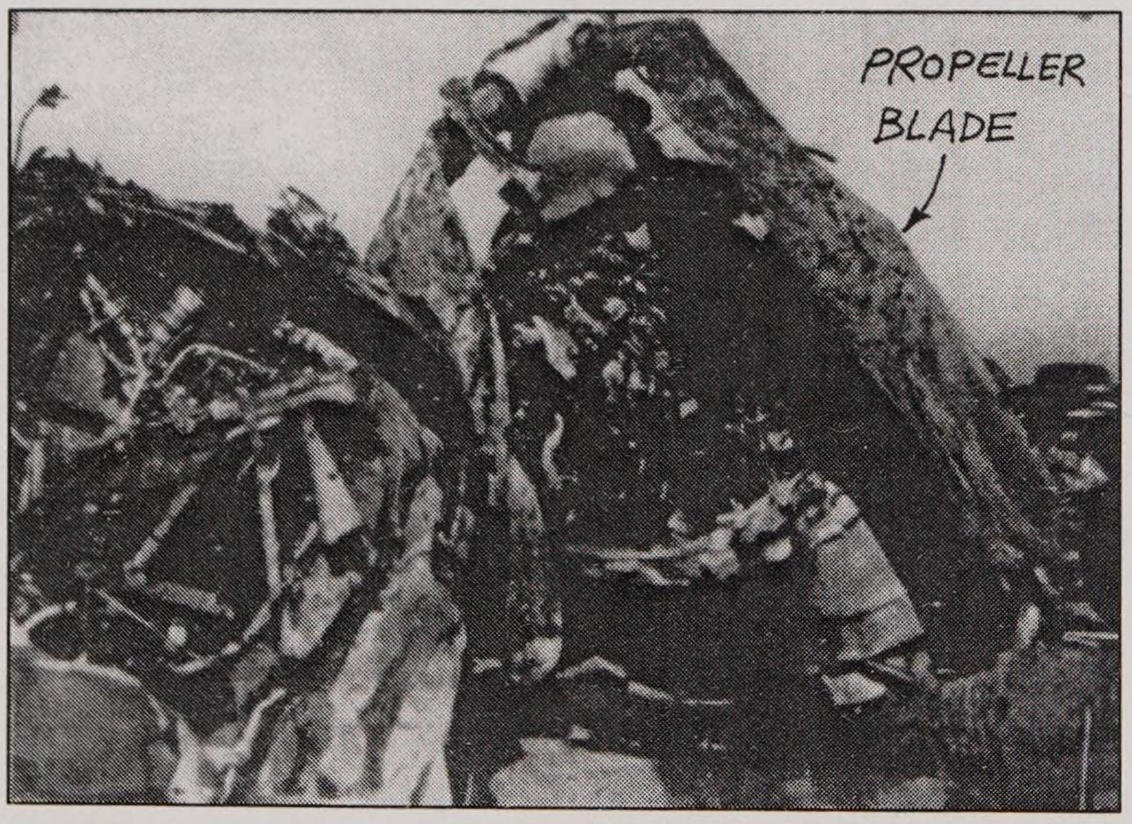
After the last practice missed approach was flown down to 2,000 feet, the aircraft climbed out to the southeast over the choppy, wind-swept waters of Choctawhatchee Bay and prepared for an approach to a full-stop landing. As the XR-12 gained altitude, Hendrix noticed a faint electrical burning smell in the cabin. Three minutes later, despite the aircraft's engines remaining synchronized and producing full power, tachometer readings for the number-two engine fluctuated and then suddenly dropped to zero on the co-pilots' and flight engineer's control panels while that engine's carburetor air temperature reading swept to "full hot." Now climbing through 3,000 feet, everything else aboard the XR-12 seemed normal. Thirty seconds later, its left inboard

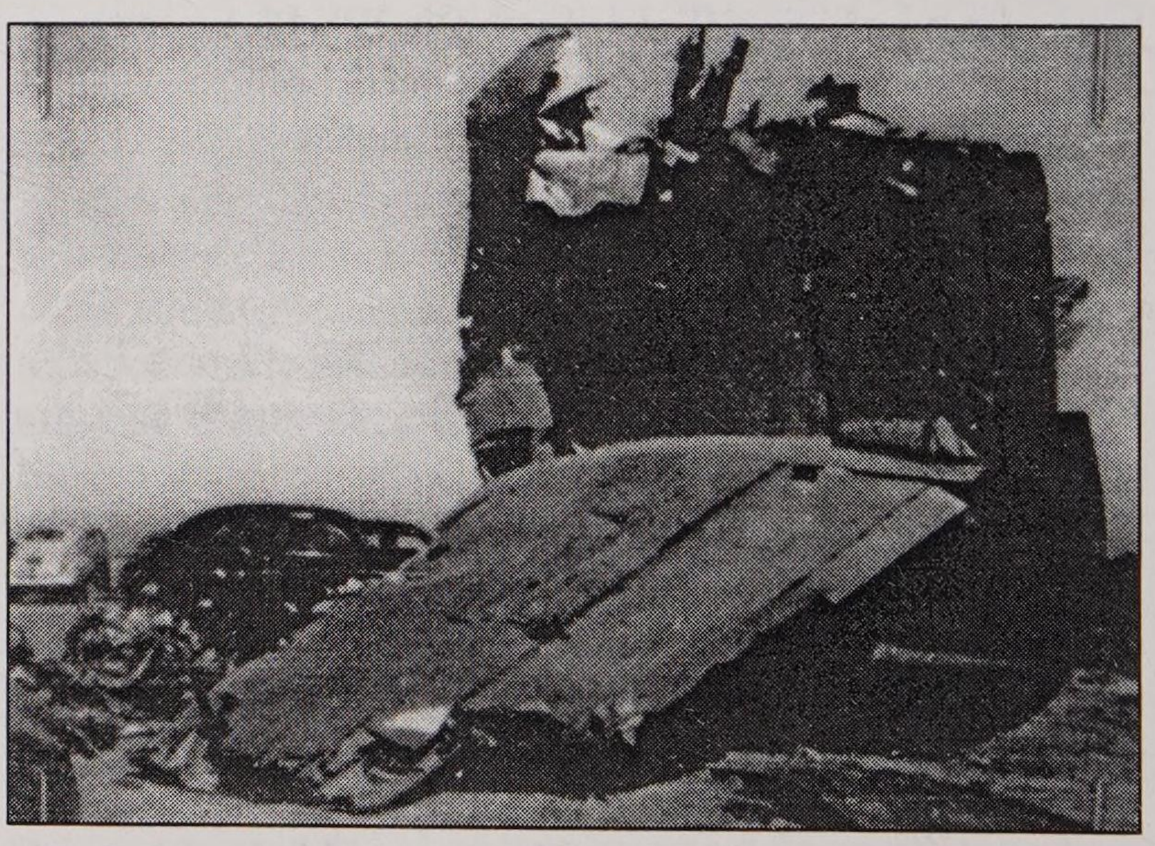




Images on this page were taken from copies of microfilm crash-investigation photographs showing the recovered XR-12 wreckage. Here we see a close-up of the number-2 engine nacelle's internal structure with the high-pressure fuel line still attached to the number-2 fuel pump (upper right). Wreckage was retrieved from a depth of 25 feet by salvage crews within two weeks of the accident. (U. S. Air Force via Accident-Report.com)

Copy of post-crash photo showing same fuel line rotated 180 degrees by crash investigation personnel reveals the rub pattern and subsequent rupture caused by the rubber fuel line chafing against the engine casing. This breach resulted in the fuel leak and subsequent explosion and fire. Fuel lines for all four XR-12 engines had been changed several months prior to the accident. (U. S. Air Force via Accident-Report.com)





Force of impact is shown in this photo of XR-12 engine with three of its four propeller blades still attached and bent back almost 90 degrees. It is quite possible that one blade was knocked off by debris from the explosion and the remaining hollow steel blades were then heated by fire, rendering them pliable on impact. Other engines were missing all four propeller blades. (U. S. Air Force via Accident-Report.com)

All that remained of the XR-12's distinctive and once-graceful tail section is shown here after it was salvaged from 25 feet of water in Choctawhatchee Bay. After the massive explosion and fire in the left inboard nacelle, the crippled aircraft dove from 3,000 feet and impacted the water in a 60-degree left bank and 45-degree nose-down, attitude. Note cars parked in the background for scale. (U. S. Air Force via Accident-Report.com)

engine nacelle suddenly exploded and disintegrated into a bright ball of black-orange flame.

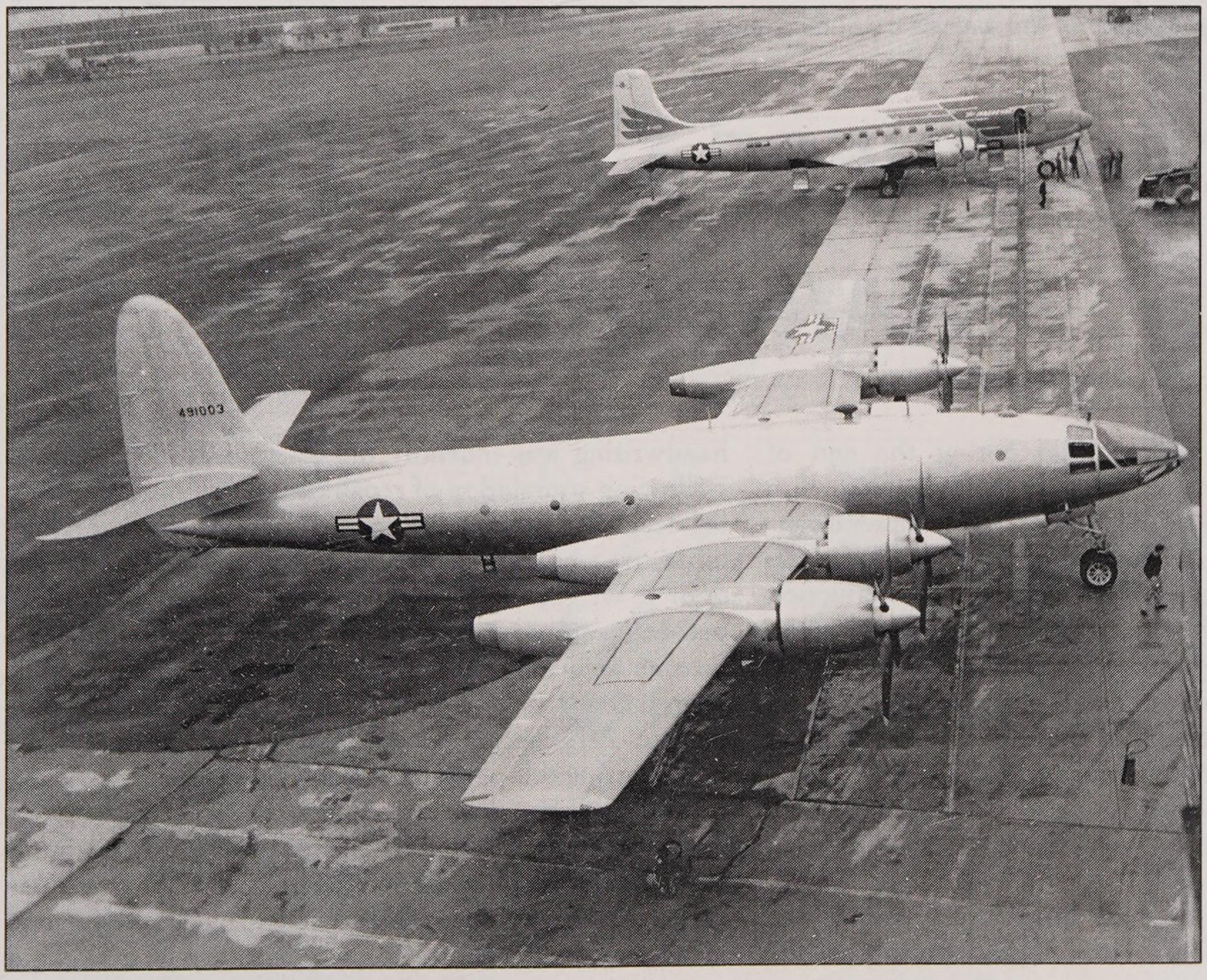
As the flight crew wrestled the controls, the airplane began buffeting severely while banking to the left. Now descending more rapidly, the XR-12 trailed a sheet of bright orange flame from its number-two nacelle that extended almost back to the tail, and Hendrix signaled the crew to bail out. Flight engineer Lee had already moved aft to visually inspect the errant engine and actually witnessed the explosion, but with the left-hand overwing emergency exit now blocked by intense smoke and fire, he moved quickly to the main entry door on the left side of the fuselage and wrestled the balky portal open.

As was typical for long-duration tests, the three photographers in the aft fuselage had removed their parachutes and Mae West life preservers in flight, and now had to quickly strap on these apparatus. Six crewmen managed to bail out successfully, but Sgt. Palmer remained in the aft fuselage unable to jump. The now-doomed XR-12 continued its death spiral and impacted the water in a steep left bank and 45-degree nose-down attitude. Capt. Morgan had been the last to exit the ship at only 1,000-feet, and although MSgt. Riberdy bailed out successfully, he sustained severe head injuries on landing and was unable to release his parachute harness. Initially listed as "missing," his body was not found until five days after the accident, when it was determined that he had drowned after being dragged under the surface by his parachute in the heavy winds.

Within minutes of the XR-12 crashing and quickly sinking out of sight, the five surviving crewmembers were spotted by a Navy fighter plane from nearby Naval Air Station Pensacola. Attracted to the scene by the plume of thick black smoke rising up from the water's surface, the Navy pilot radioed Eglin's tower to initiate rescue efforts. All five men had deployed their water survival dye marker, and were soon retrieved by air/sea rescue boats, one privately owned vessel, and two rescue helicopters dispatched from shore. They were returned to Eglin several miles to the northwest, wet and shaken, but glad to be alive.

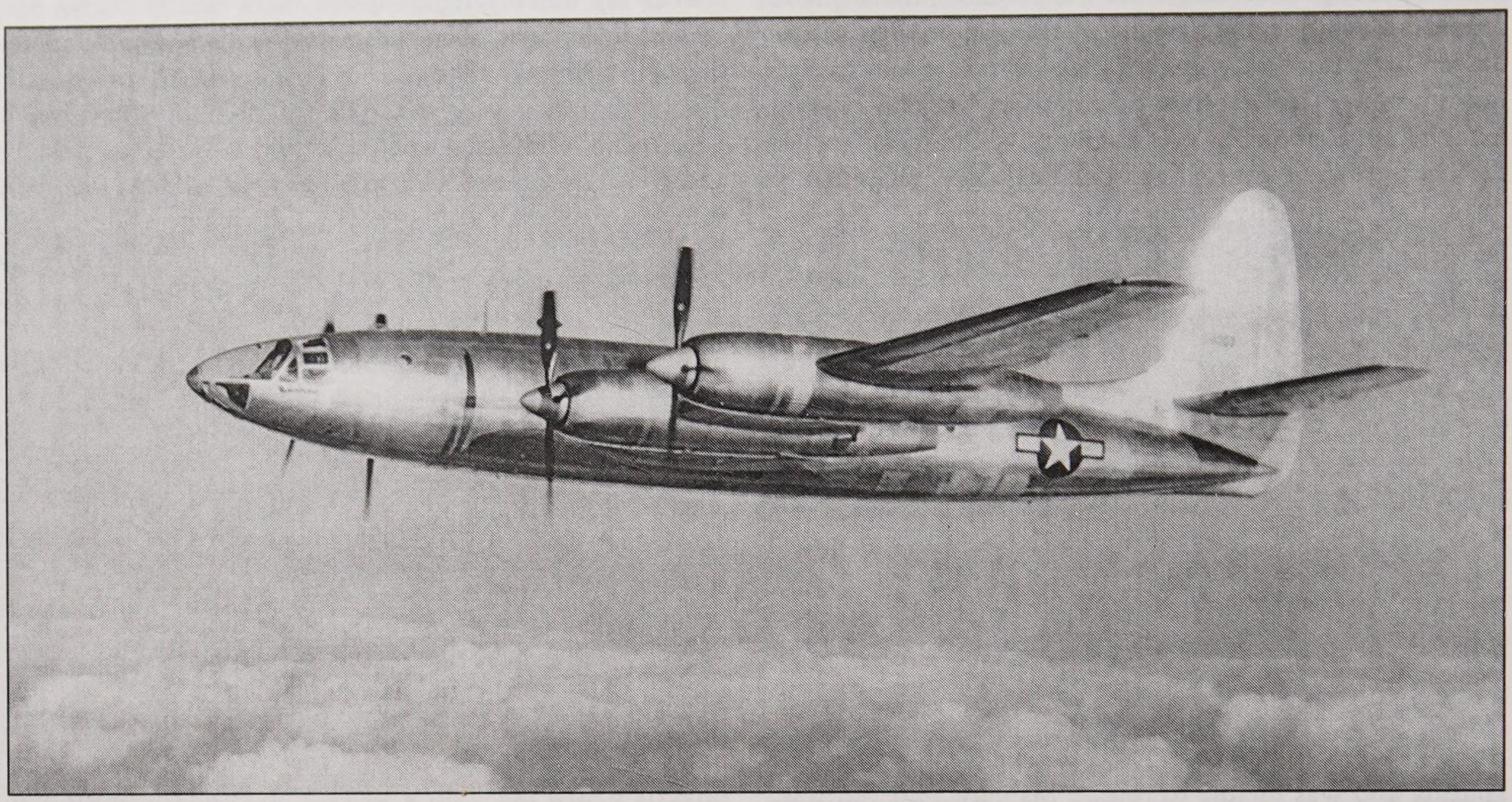
Major portions of XR-12 wreckage were recovered from the muddy bottom of Choctawhatchee Bay by salvage teams in the week following the crash, and a formal investigation into the cause of the accident was begun. After careful analysis it was determined that a fuel leak, and not an engine explosion as first thought, was the probable cause of the accident. Fuel from a chafed high-pressure hose had pooled at the bottom of the number-two nacelle, and was ignited by a spark from an electrical junction box inboard of the engine. The tachometer readings had dropped to zero when their sending wires burned through, as did the wires for that engine's 24-point fire warning system. The explosion occurred directly below the main wing spar and tore the bottom of the nacelle off the airplane.

Sadly, the fact that parachutes and life preservers were not being worn inflight by the photo technicians was also identified as a primary causal factor in both fatalities.



Beautiful bird's-eye view of the second XF-12 taken from the control tower adjacent to Hangar 3. Aircraft is parked next to President Harry S. Truman's personal Douglas VC-118 (DC-6) named Independence for the president's home town in Missouri. It is not known if Truman himself was visiting the plant that day. Note painted walkway markings on the XF-12's upper wing surfaces. (Cradle of Aviation Museum via Dennis R. Jenkins)

Chapter Ten



The world's fastest four-engine piston-powered aircraft soars above the clouds on its maiden flight in February 1946, a proud symbol of America's aviation prowess in the years following World War II. Few could have predicted the dire outcome of this program, with so much hope and expectation riding on the potential effect it would have had on both Republic and the airline industry. With the anticipated success of its F-84 Thunderjet series, RC-3 Seabee amphibian, military F-12A, and RC-2 airliner, the company would have been assured of solid growth and perseverance as a major player in the aircraft manufacturing game. (Cradle of Aviation Museum via Dennis R. Jenkins)

SOMEWHERE OVER THE RAINBOW

If there was ever a proverbial pot at the end of Republic's Rainbow, it certainly wasn't filled with gold. After the tragic loss of Ship Two, coupled with cancellations of both the airplane's military and commercial airline contracts, all hopes of seeing either the production F-12A photo-recon aircraft or RC-2 airliner enter series production were gone forever. Republic would now be known only as a builder of single-seat, single-engine jet fighter-bombers. That is, until the company was bought by a large aviation conglomerate in 1965.

The XR-12's Last Gasp

Although Republic had hoped to prolong the inevitable, after the loss of the second prototype, the handwriting was indelibly on the wall at Farmingdale. Following completion of repairs from its July 1947 landing accident (and another incident where its vertical stabilizer tip was sheared off after hitting the top of a hangar door at Wright Field), the first XR-12 prototype continued being flown by Republic until late 1948, and then became an Air Force ferry aircraft and squadron hack from January 1949 to June 1952 when it was placed into storage. After accumulating nearly 120 additional flight hours during this period, the airplane was finally stricken from the Air Force inventory in early 1953.

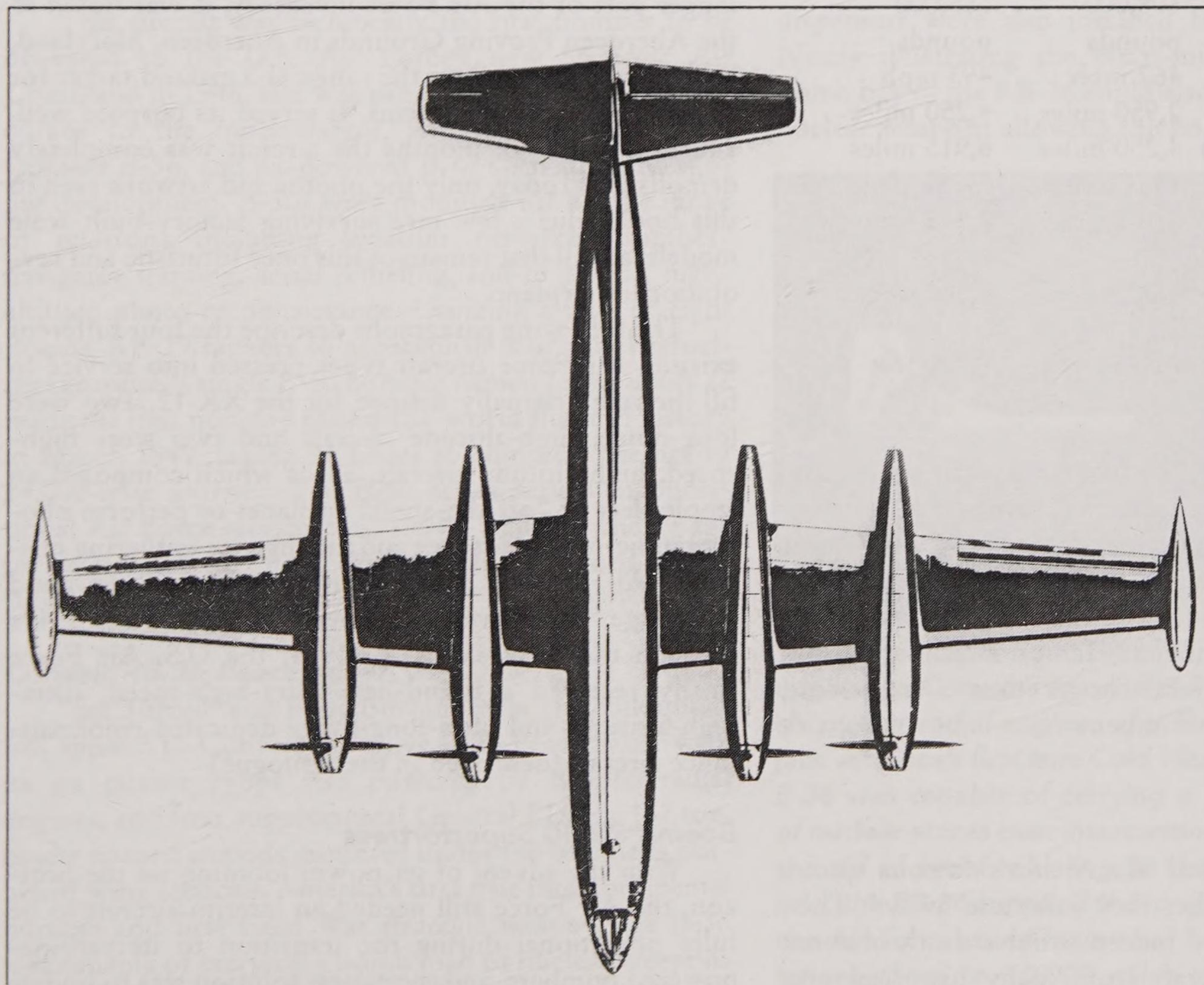
Even though Republic realized there was no more chance of producing the XR-12 or its Rainbow airliner variant, company engineers set out to work on yet one more proposal to resurrect the possibility of building a

large four-engine airplane for the Air Force. Named the AP-60 "Four-Engine Turbo-Combination Aircraft," this advanced design was to use a new powerplant combining the attributes of both a piston and a turbine engine in the same nacelle. With projected performance even greater than the XR-12, this new proposal was intended to serve as a possible interim aircraft to either augment or replace the B-47 jet bomber on certain types of missions. In November 1948, the Air Force Directorate of Requirements and Directorate of Research and Development expressed initial interest in such an aircraft, and Republic entered into exploratory discussions with the Air Materiel Command.

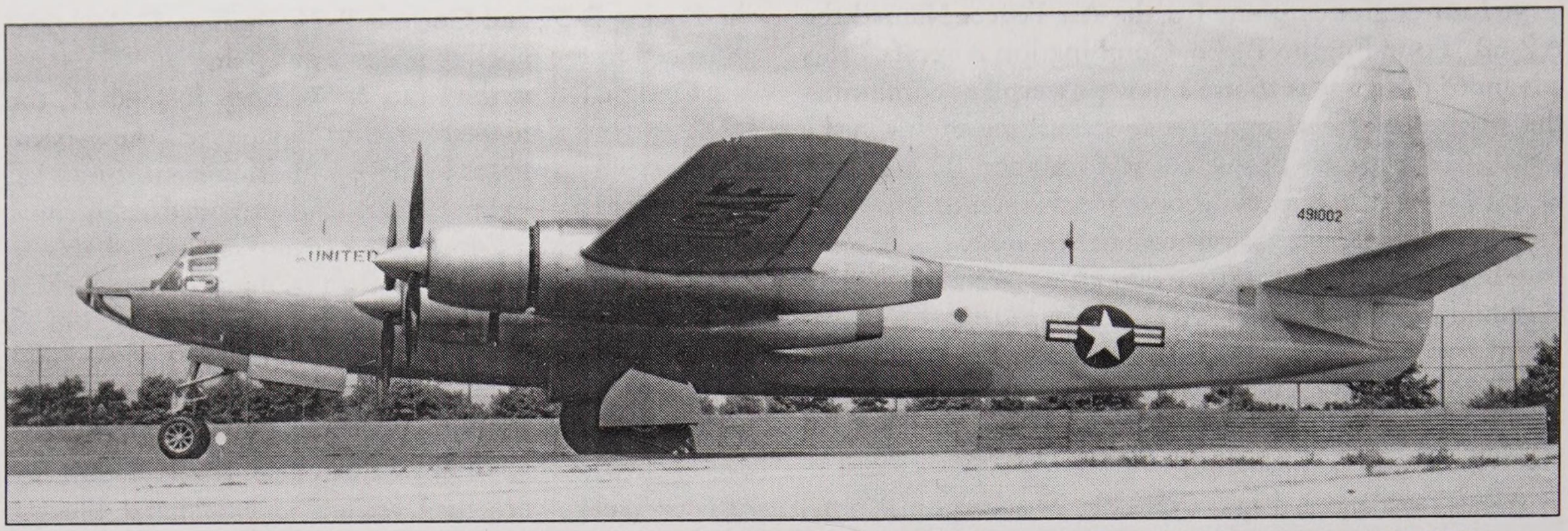
Powered by a VDT (Variable Discharge Turbine) engine, the AP-60 would have represented the ultimate in performance for a multi-engine piston-powered aircraft by combining the sleek aerodynamics of the XR-12 with a new powerplant that took the concept of the reciprocating piston engine to its final threshold. The VDT concept was envisioned by Pratt & Whitney to maximize the output of the R-4360 Wasp Major by eliminating heavy and complex turbo-superchargers, and replacing them with the piston equivalent of a turbojet's afterburner. In so doing, an estimated boost of roughly 200 pounds of thrust, or 300 hp per engine, could be achieved with subsequent increases in speed, payload, and range. This novel hybrid powerplant was also being considered for use on the Boeing B-50 and Convair B-36, studies of which had advanced to the mockup stage at this point.

Designated as the Pratt & Whitney R-4360-51, the VDT powerplant essentially harnessed the piston engine's exhaust gases to drive a multi-stage turbine that boosted piston engine output, and provided augmented jet thrust as well. Comprised of four separate elements, the VDT used the R-4360 piston engine as its main component, a variable-discharge turbo-supercharger, and an aftercooler (which was used to cool the compressed fresh air before it was routed into the engine cylinders, thus boosting performance at the beginning of the power cycle). In the final step of this cycle, the R-4360's hot exhaust gases were then routed to a General Electric CHM-2 turbine mounted at the extreme aft end of the nacelle where they were compressed by that unit's turbine rotors, ignited with fuel, and then ejected out the tailpipe, much like a turbojet does.

The following table illustrates the dramatic performance increases in speed, payload, and range of the VDT-equipped F-12A over the XF-12 as shown in a report published by Republic on 29 September 1948. It is interesting to note that the designations F-12A and XF-12 were still being used in this report despite the Air Force having changed all its aircraft designations one month earlier, with "F" for photographic becoming "R" for reconnaissance.



Rare factory rendering depicts plan view of the proposed F-12A with Pratt & Whitney R-4360-51 VDT (variable discharge turbine) engines. Predicted to be capable of speeds of nearly 500 mph in level flight, this aircraft featured a lengthened forward fuselage, air intakes in the prop spinners, an extended leading edge between each set of engines, and 600-gallon tip tanks for extended range. (Republic Courtesy of Tim Williams)



Final antenna configuration and Air Force markings for XR-12 Ship One are seen here in the summer of 1949 in one of the last photos ever taken of the airplane at Farmingdale. Note the stenciled lettering style for the "United States Air Force" title on the forward fuselage, and the aircraft's sliding-ring cowl flaps shown in the full open position. The XR-12 had a pronounced nose-up deck angle while on the ground and a retractable tail bumper was integrated into the bottom of the ventral fin to protect the rear fuselage during takeoffs and landings. Maximum angle of rotation on takeoff was only 7 degrees. (Cradle of Aviation Museum via Dennis R. Jenkins)

	XF-12	F-12A
Engine	R-4360-37	VDT (C3)
Turbo Ratio	N/A	81
Normal Gross Weight	100,565 pounds	140,000 pounds
Normal Fuel	4,350 gallons	8,000 gallons
Overload Gross Weight	108,000 pounds	155,000 pounds
High Speed	462 mph	493 mph
Range (Normal Fuel)	2,950 miles	4,250 miles
Range (Maximum Fuel)	4,250 miles	6,915 miles
Service Ceiling	45,000 feet	35,000 feet
Rate-of-Climb (Sea Level)	2,100 fpm	2,275 fpm
Takeoff Over 50-foot Obstacle	3,000 feet	4,500 feet
Landing Over 50-foot Obstacle	3,300 feet	4,700 feet

Despite the projected performance numbers indicating a propeller-driven airplane of immense possibility, the Air Force's review determined that the AP-60 project was simply too little, too late. In January 1949, only three short years after the rollout of the first XR-12 prototype, the final axe fell on Republic's hopes to ever produce an aircraft larger than a single-seat, single-engine jet fighter-bomber.

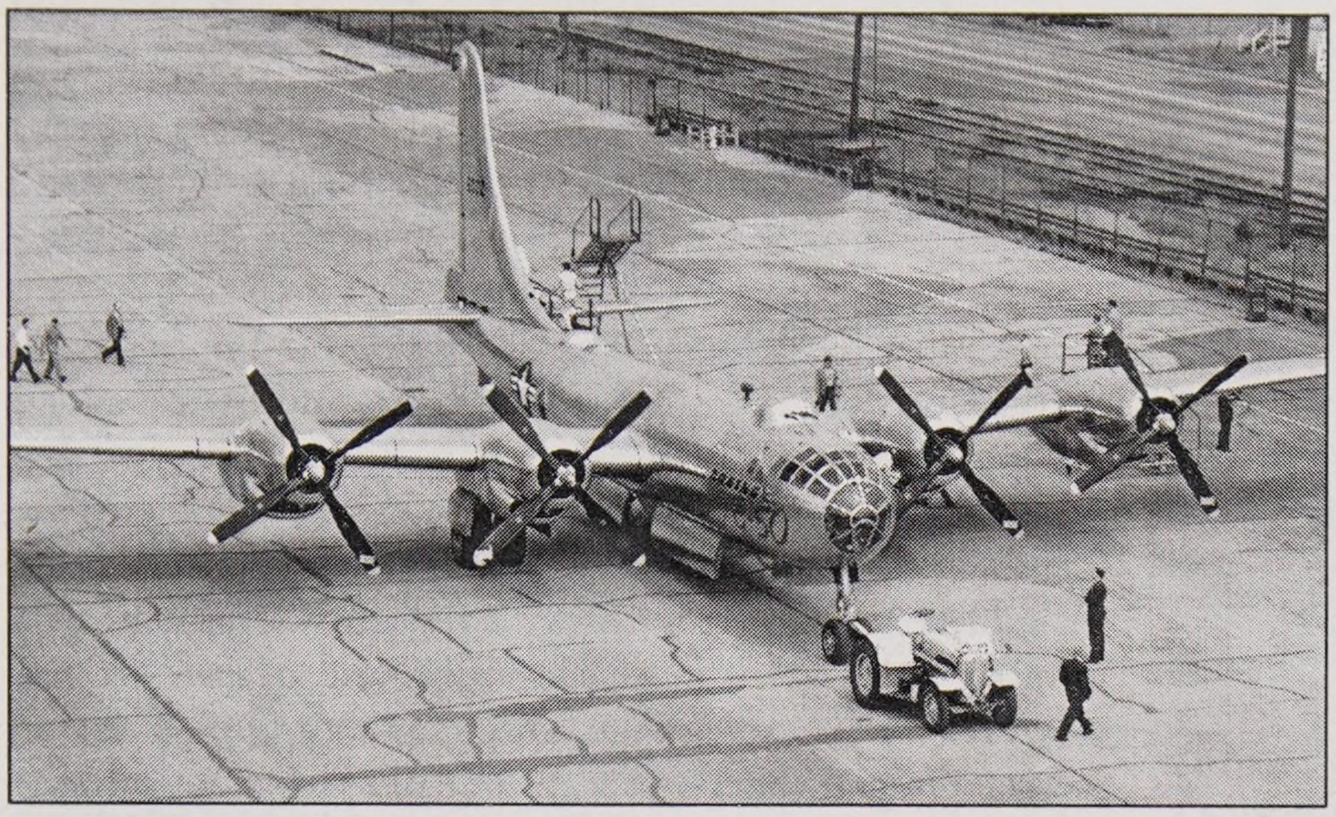
End of the Road

Paraphrasing General MacArthur's famous quote, "Old airplanes never die, they just fade away." Then again, some airplanes do indeed suffer a death of sorts. While noteworthy aircraft from many historical eras have been saved for posterity and properly retired to hallowed display spaces in national aviation museums, other equally rare aircraft have either been scrapped under a guillotine or melted into ingots at the hands of a smelter. As beautiful and successful a flying machine as the sole surviving Republic XR-12 Rainbow was, that aircraft suffered a cruel fate even worse than being scrapped: No longer part of the Air Force inventory, it was flown to the Aberdeen Proving Grounds in Aberdeen, Maryland, in 1953 to be parked on the range as a ground target for testing new artillery systems. It served its purpose well, and in a matter of months the aircraft was completely demolished. Today, only the photos and artwork seen in this book, plus a few rare surviving factory-built scale models, are all that remain of this once futuristic and revolutionary airplane.

The following paragraphs describe the four different existing Air Force aircraft types pressed into service to fill the role originally defined for the XR-12. Two were long-range, high-altitude aircraft and two were high-speed, high-altitude aircraft, all of which composed an ample fleet of "off-the-shelf" airplanes to perform photographic-reconnaissance and intelligence-gathering missions. All four of these aircraft were used to good advantage, and served collectively from the late 1940s through the early 1960s. In 1964, the U.S. Air Force finally received a brand-new ultra-high-speed, ultra-high-altitude, and ultra-long-range dedicated reconnaissance aircraft (described in the Epilogue).

Boeing RB-50 Superfortress

With the advent of jet power looming on the horizon, the Air Force still needed an interim aircraft to be fully operational during the transition to its turbine-powered bombers, and the easiest solution was to update an existing design. The optimum aircraft for this role



A slightly larger and more powerful version of the legendary B-29, the Boeing B-50 was powered by the same Pratt & Whitney R-4360 Wasp Major radial engines as the XR-12 and XF-11. It was technically the first bomber delivered to the new U.S. Air Force's Strategic Air Command in 1948, and was pressed into service as an interim step toward the larger, longer-range Convair B-36 then still under development. B-50s were modified for a wide range of missions including weather research, aerial refueling, and of course, high-altitude photo reconnaissance. (National Archives via Dennis R. Jenkins)

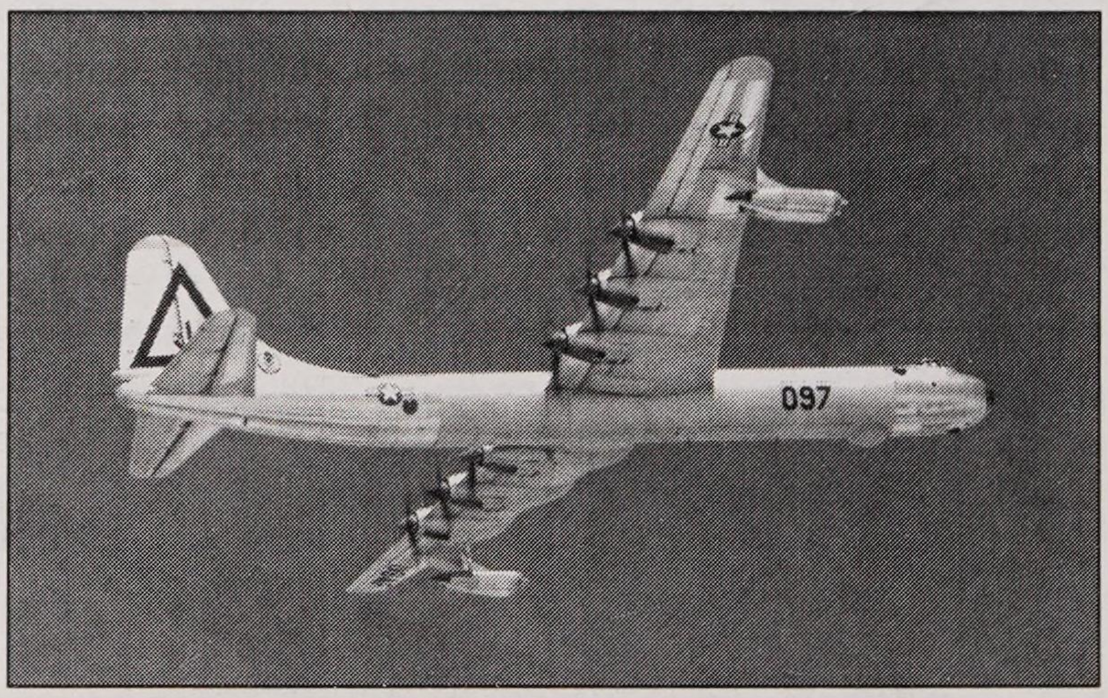
would also have to be easily adaptable to the USAF inventory. Boeing was able to meet that requirement with the B-50, an improved, heavier, and more powerful version of its legendary B-29. Originally designated the B-29D and still retaining the name Superfortress, the B-50 was powered by the same Pratt & Whitney R-4360 Wasp Major radial engines as the XF-11 and XR-12. Nearly identical in overall dimensions to its B-29 predecessor, the B-50 featured a 5-foot-taller vertical stabilizer to provide necessary lateral stability for handling engine-out operation and the increased power of its new 3,500-hp engines.

This aircraft was technically the first bomber to be delivered to the U.S. Air Force's new Strategic Air Command in 1948, and was pressed into service as a precursor to the much larger, and much longer-range Convair B-36, and jet-powered B-47 then still undergoing development. B-50s were modified for a wide range of missions including weather research, bomber/navigator training, aerial refueling, and of course, high-altitude photo reconnaissance. Utilizing a fleet of eight Boeing KB-29 tankers to accomplish four aerial refuelings enroute, a single B-50 bomber named *Lucky Lady II* made the first nonstop round-the-world flight in history in March 1949, taking 94 hours to complete the nearly 24,000-mile journey. The B-50 series served in operational Air Force service until 1964—well into the jet age for an airplane that had been originally designed during World War II.

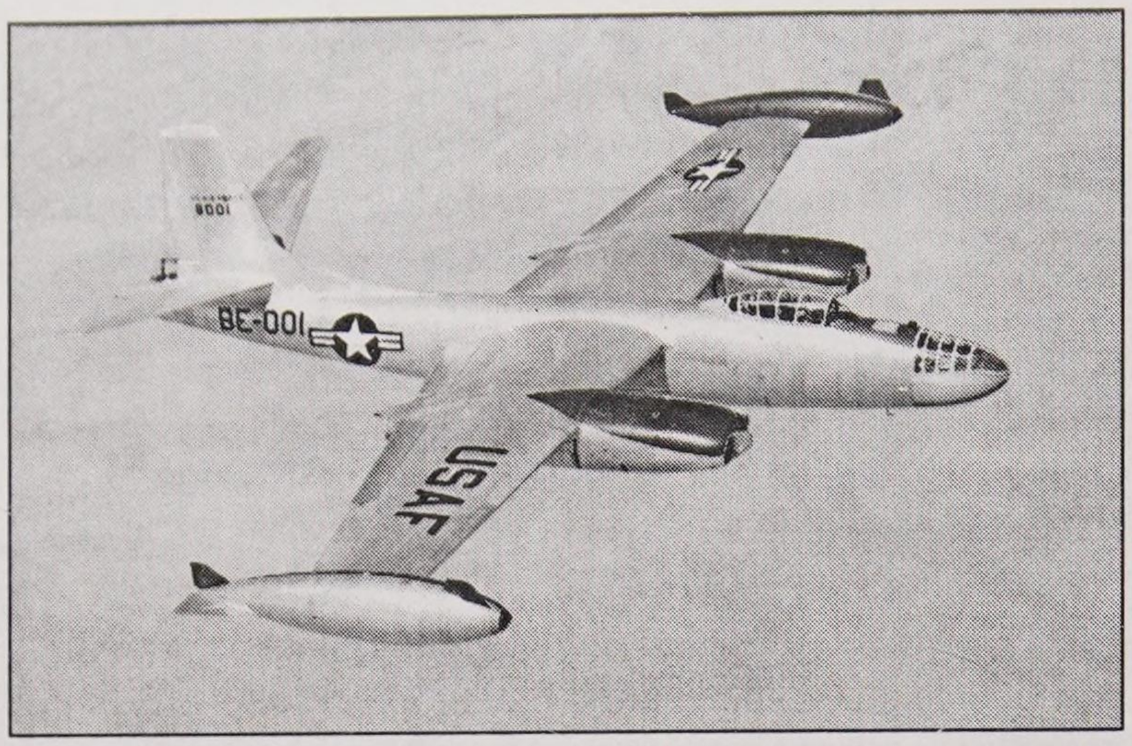
Convair RB-36 Peacemaker

"Six Turnin' and Four Burnin'" was the colloquialism applied to Convair's massive B-36 Peacemaker with its six pusher props also powered by R-4360 radial engines, and four supplemental General Electric J47 turbojets housed in pods mounted under the bomber's outboard wing sections. America's first true intercontinental bomber and first Cold War strategic weapon, the B-36 was capable of carrying a bomb load of nuclear weapons over distances of up to 10,000 miles without aerial refueling (for which it was not equipped). While payload, range, and endurance were the B-36's strong suits, speed was not, as the aircraft cruised at 290 mph. With jet augmentation, top speeds could be boosted to nearly 400 mph, but only for short durations.

Pressed into service for high-altitude photo-reconnaissance and intelligence-gathering missions in 1950, the bomber was modified into the RB-36 model by converting its four massive bomb bays into pressurized camera stations, facilities for housing electronic countermeasures equipment, and space for additional fuel storage. Photo flash bombs were carried for night operations, and chaff dispensers were also installed for defensive measures. Nicely illustrating the multi-mission concept, the aft bomb bay of the RB-36 could also be configured to carry nuclear weapons allowing the bomber to supplement its



"Six Turnin' and Four Burnin'" was the colloquialism applied to Convair's massive B-36 Peacemaker, with its six pusher radial engines and four supplemental turbojets. America's first true Cold War strategic weapon, the B-36 was capable of carrying a 10,000-pound payload of nuclear stores over intercontinental distances without the aid of aerial refueling. In the photo-reconnaissance role, the RB-36 supplied the longest-range recce aircraft the Air Force could have ever hoped for, covering distances of up to 10,000 miles at a service altitude of 35,000 feet. (National Archives via Dennis R. Jenkins)



The Air Force's first operational turbojet bomber, the North American B-45 brought jet speeds to America's bomber force. Although equipped with a straight wing and powered by four 5,200-pound-thrust General Electric J47 turbojets, the B-45 could reach speeds of 550 mph at 40,000 feet. Equipped with a photo-recon payload consisting of five camera stations equipped with a total of ten cameras, the Tornado became the first U.S. jet-powered photo-reconnaissance aircraft. Use of the Tornado in the photo-recon role also added several more years of service life to an aircraft that was becoming obsolescent as newer swept-wing jet bombers entered the inventory. (National Archives via Dennis R. Jenkins)

photo-recon mission responsibilities and operate as a long-range bomber as well.

North American RB-45 Tornado

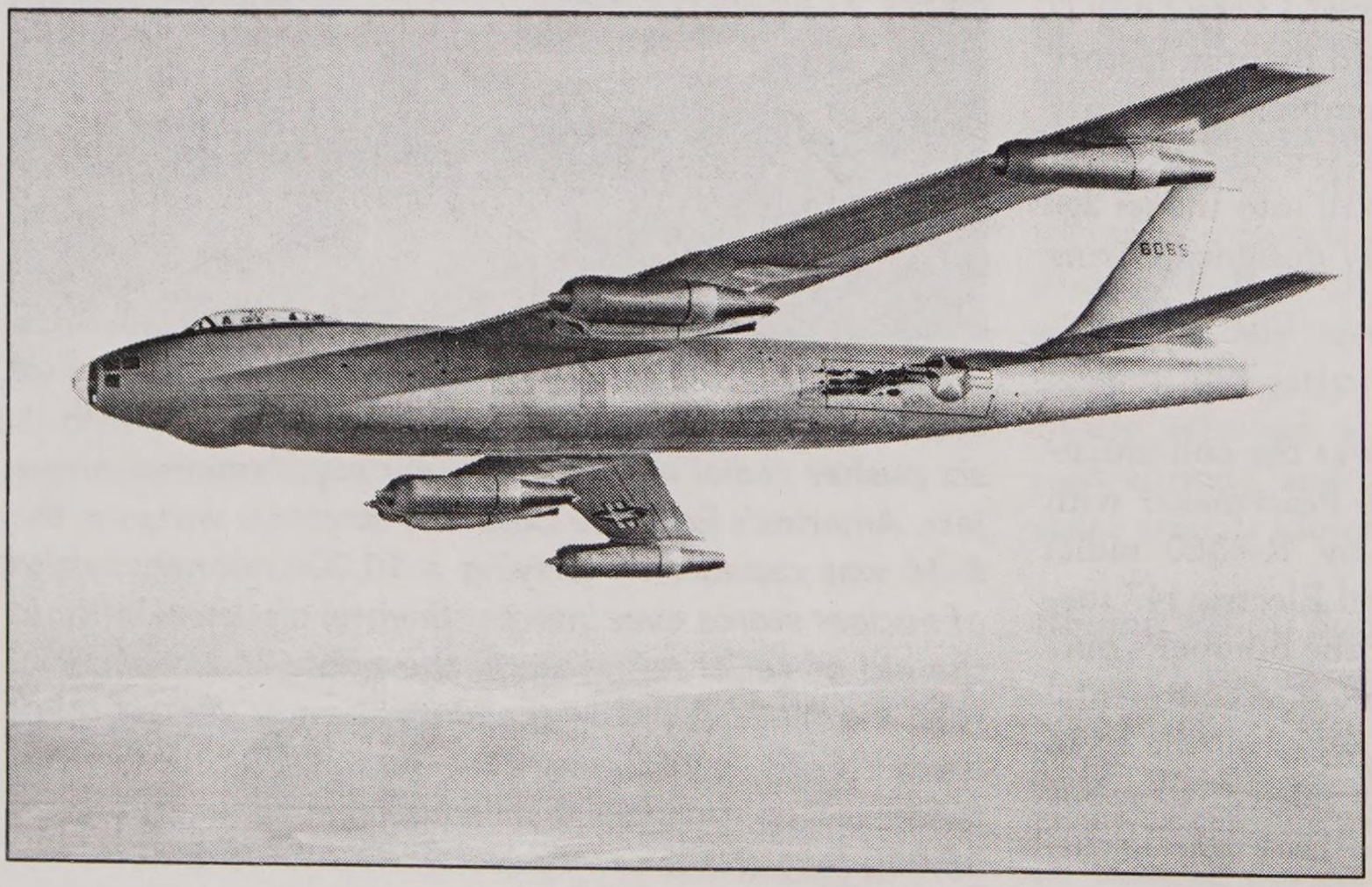
As the Air Force's first operational jet bomber, the North American B-45 Tornado brought jet-powered speed and reliability to America's bomber forces. Although fitted with a thick straight wing and powered by four 5,200-pound-thrust GE J47 turbojets housed two-each in pods nestled underwing, the B-45 could achieve speeds of 550 mph at 40,000 feet. Equipped with a photo-recon payload consisting of five camera stations outfitted with a total of ten cameras, the RB-45 Tornado differed externally from the bomber version by the deletion of the bombardier's glass nose section.

Almost by default, the RB-45 became the first U.S. turbine-powered photo-recon aircraft, and its use added several more years of service life to an aircraft type that was fast becoming obsolescent as newer swept-wing jet bombers entered service. However, by not having inflight refueling capability, the RB-45 was limited to a combat radius of only 1,200 miles, and despite its jet-powered speed advantage, the acquisition of a faster, longer-range, "next-generation" photo-recon aircraft was becoming a definite requirement for the newly created U.S. Air Force.

Boeing RB-47 Stratojet

The Air Force finally realized its goal of procuring a high-speed, high-altitude, multi-engine reconnaissance and intelligence-gathering aircraft for its inventory when, in 1954, the Boeing RB-47E entered operational service. Modified for the strategic reconnaissance mission with the elimination of all bombing equipment, the RB-47E carried 11 cameras along with 10 photo flash bombs for night operations. However, the bomber's original 20mm tail guns were retained for defensive measures. Capable of 572 mph at 20,000 feet, photo-recon Stratojets were also used for detecting and locating ground-based radar sites.

The ERB-47 was a further-modified version of the RB-47 model that could house additional crewmen in a special pressurized crew compartment carried in the aircraft's bomb bay. These crewmen, called "Ravens," conducted electronic intelligence-gathering missions over sensitive military targets during the early years of the Cold War.



Epitomizing the look of the coming jet age, Boeing's B-47 utilized a 35-degree swept wing and tail, podded J47 turbojet engines, and a large bubble canopy as seen on this early development model. Reflecting on the Stratojet's superlative performance for such a large airplane, famed Air Force test pilot Col. Joe Cotton called it "The bomber pilot's F-80 Shooting Star." The RB-47 version had a slightly longer all-metal nose section and special provisions for photo-recon gear housed in its bomb bay. (Author Collection)

Flying the ERB-47 Mission

By John K. Lewis (Maj. USAF, Ret.)

Before Lockheed Aircraft's chief designer, Kelly Johnson, and his Skunk Works team produced the U-2 and SR-71, existing aircraft not specifically designed for reconnaissance work were pressed into service to fill that role. One of those aircraft was the Boeing B-47 Stratojet. Boeing took full advantage of technology discovered in Germany after World War II, including data indicating that sweeping an aircraft's wings would provide a substantial improvement in performance. Although originally designed as a high-altitude medium bomber, the B-47 performed quite well in the high-speed reconnaissance role.

The advantages of higher altitude and, especially, faster speed worked well in allowing the RB-47s and ERB-47s to conduct their special missions without the danger of interception; at least that was the theory announced by intelligence personnel. In reality, advances in Russian aircraft design were well ahead of U.S. estimates, and on far too many occasions ELINT (Electronic Intelligence) aircraft were intercepted, fired upon, damaged, or even lost while conducting their secret reconnaissance missions.

In the early days of the Cold War, B-47 aircraft had nuclear weapons loaded in the bomb bay without the nuclear core installed. This was done as a safety measure in case of a takeoff or landing accident, inflight emergency demanding bailout, or inadvertent loss of the bomb due to a malfunction. In order to make the bomb operational, the navigator/bombardier had to crawl through a narrow tunnel from the cockpit to the bomb bay [to insert the core into the bomb]. This was done en route to the target if a valid strike message had been received. This same tunnel became a tool in spy missions when it was used by ECM (Electronic Countermeasures) crewmen to transit from the cockpit to a pressurized capsule in the bomb bay. The capsules contained downward ejection seats that couldn't be used at low altitude during initial climb or in the final approach and landing phase of flight.

In order to provide a means of escape, the Ravens rode in the aisle adjacent to the pilot and copilot positions. They were provided with harness slings so they could brace themselves in case of an aborted takeoff or emergency landing. In the event of a low-altitude bailout they would jettison the main entrance hatch that caused a spoiler to be deployed. The spoiler was designed to provide separation from the airframe and aided in safely leaving the aircraft. Procedures called for exiting feet first while facing aft. Due to oxygen considerations, transition to their duty stations in the capsule was accomplished before climbing through 10,000 feet MSL (mean sea level). Once they reached their crew positions, checked-in on intercom, and confirmed the capsule was pressurizing safely, further climb to cruising altitude was commenced. This procedure was reversed during the descent, approach, and landing.

The capsule in my ERB-47E contained two ejection seats that faced aft with a bank of ECM equipment located in the rear section of the capsule. Some ELINT aircraft carried three ECM operators, which must have made for very crowded conditions. The only defense available to the crews was a gun turret in the tail containing two radar-guided 20mm cannons. It was important that these cannons be "charged" with live rounds prior to the guns becoming "cold soaked" in order to have any chance of them working at high altitude. For safety reasons live rounds weren't [inserted in the cannons] prior to takeoff and the gun barrels were tilted as far up as the turret allowed. Charging the guns was accomplished during initial climb. It required the co-pilot to first tilt and then rotate his ejection seat 180 degrees to face aft where the gun controls were located. During this phase of operation the co-pilot's ejection seat could not be used for emergency bailout purposes.

ELINT operations flew from some of the most remote bases in the free world. Among them was Thule Air Base, Greenland, which is located well above the Arctic Circle. It offered routes over the North Pole directly to Soviet airspace. Eielson AFB, Alaska, offered similar proximity. RAF Brize Norton in England was another ELINT base, while Incirlik Air Base in southern Turkey was used to probe the southern borders of Russia. Even with the use of these strategically located installations, it was still necessary to perform inflight refueling to accomplish these missions. Long before the turbojet KC-135 Stratotanker became operational the piston-powered Boeing KC-97 was the refueling aircraft of choice. Its basic designed came from B-29 and B-50 bombers.

Four massive Pratt & Whitney R-4360 engines powered the KC-97s. It was necessary to operate these engines near METO (Maximum Except Take Off) power in order to accomplish aerial refueling of the B-47. If you looked from the B-47 up at the KC-97s open cowl flaps at night you could see the cylinders glowing cherry red from the high power settings. It wasn't uncommon to have a tanker lose an engine during refueling and initiate an emergency separation from the bomber. With the call, "Breakaway! Breakaway! Breakaway!" the tanker immediately climbed and the B-47 dove away after the

disconnect buttons were pressed, causing the refueling boom to not only disconnect from the bomber but to telescope to its fully retracted position.

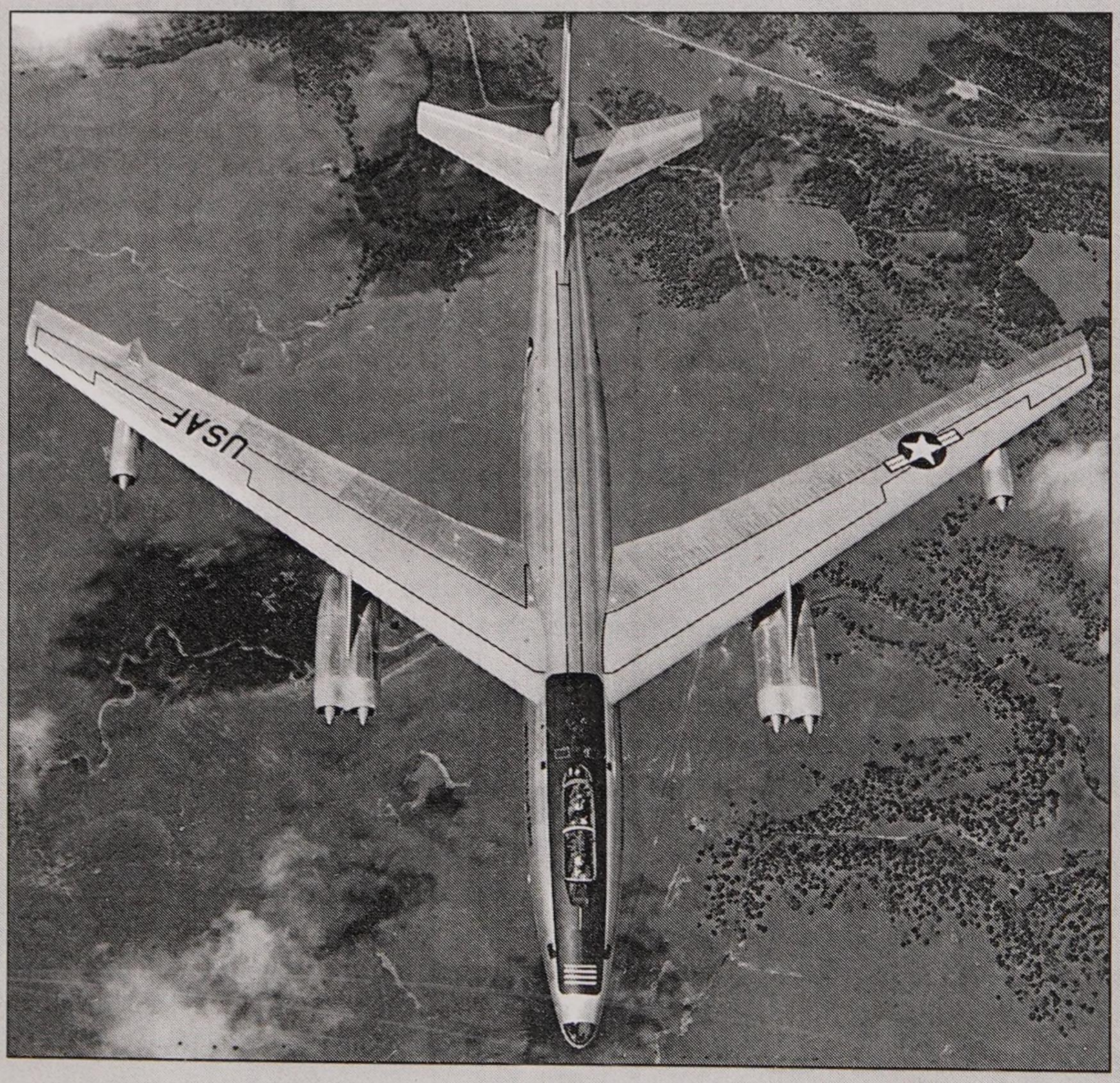
Refueling a swept-wing B-47 with its high-wing loading from a piston-engine tanker was no easy task. First, the two aircraft had to effect a rendezvous while the B-47 descended to the tanker's optimum altitude and slowed to their operational speed. Checklists contained a chart that listed beginning and ending speeds based on the existing gross weights of each aircraft. Initially the B-47's weight was relatively low due to a reduced fuel load while the KC-97's weight was high because it was carrying all the jet fuel to be offloaded. The theory was to start at a speed that was acceptable to both aircraft and accelerate as the B-47 became heavier and the KC-97 became lighter. In practice, however, these speeds weren't always achieved.

Additionally, as the B-47 took on fuel, its center of gravity moved farther and farther aft making pitch control more and more sensitive. Throw in some clouds, rain, and turbulence, or complete this same maneuver at night with any of the aforementioned conditions, and it was indeed a challenging proposition.

The B-47 started life at 125,000 pounds maximum gross weight with three main fuel tanks. In order to increase the aircraft's range, a forward auxiliary, aft auxiliary, bomb bay, and two external wing tanks were subsequently added. We would sit alert with a fully loaded B-47 tipping the scales at an incredible 218,000 pounds! In order to make a successful takeoff at this gross weight, 5,300 pounds of water/alcohol injection and 30 JATO (Jet Assisted Take Off) bottles were used. The JATO bottles burned out in 15 seconds, while the water lasted about 45 seconds. Still, takeoff rolls were very long.

No fuel was stored in the wings; every drop except for the two external fuel tanks was housed in the fuselage. In essence, the B-47 was a flying fuel tank leaving very little room for creature comforts. There was no lavatory, no galley, and no bunks. Relief tubes, thermoses of water and coffee, and cold box lunches were the daily fare. Although cockpit pressurization was provided, dehydration on long missions was ever present.

The dedicated crews who flew these dangerous missions were exceptional airmen. They risked their lives on a daily basis during the Cold War to prevent the potential horror of nuclear war. It is doubtful that they ever knew their full contribution to our freedom. The essence of these efforts was to ensure that leaders of the Soviet Union realized, without a doubt, that the United States would retaliate instantaneously if they were to ever launch an attempt at world domination.



The Air Force finally realized its goal of procuring a high-speed, long-range multi-engine reconnaissance and intelligence-gathering aircraft when the Boeing ERB-47H entered service in 1955. A heavy modification of the original six-engine B-47 Stratojet that first flew in 1947, the ERB version was intended to fill the dedicated role of photo-reconnaissance and ELINT gathering first envisioned for the Republic XR-12. Capable of speeds of up to 650 mph with a service ceiling of 42,000 feet, the six-engine, swept-wing, 175,000-pound bomber was used for oblique radar mapping, photo reconnaissance, and covert monitoring of sensitive military radio and radar transmissions all over the world. (Author Collection)

End of the line for Republic occurred in September 1965 when the 25-year-old company was purchased by the Fairchild Hiller Corporation. With the exception of the A-10 Thunderbolt II close air support aircraft and stillborn T-46 Air Force trainer, the F-105 Thunderchief was the last full production aircraft to roll out the doors of Building 17 at Farmingdale. Pictured here in 1959 are new all-weather F-105Ds in final assembly. Republic's PR Department called the Thunderchief "the most powerful one-man airplane in the world." (Republic via Author Collection)

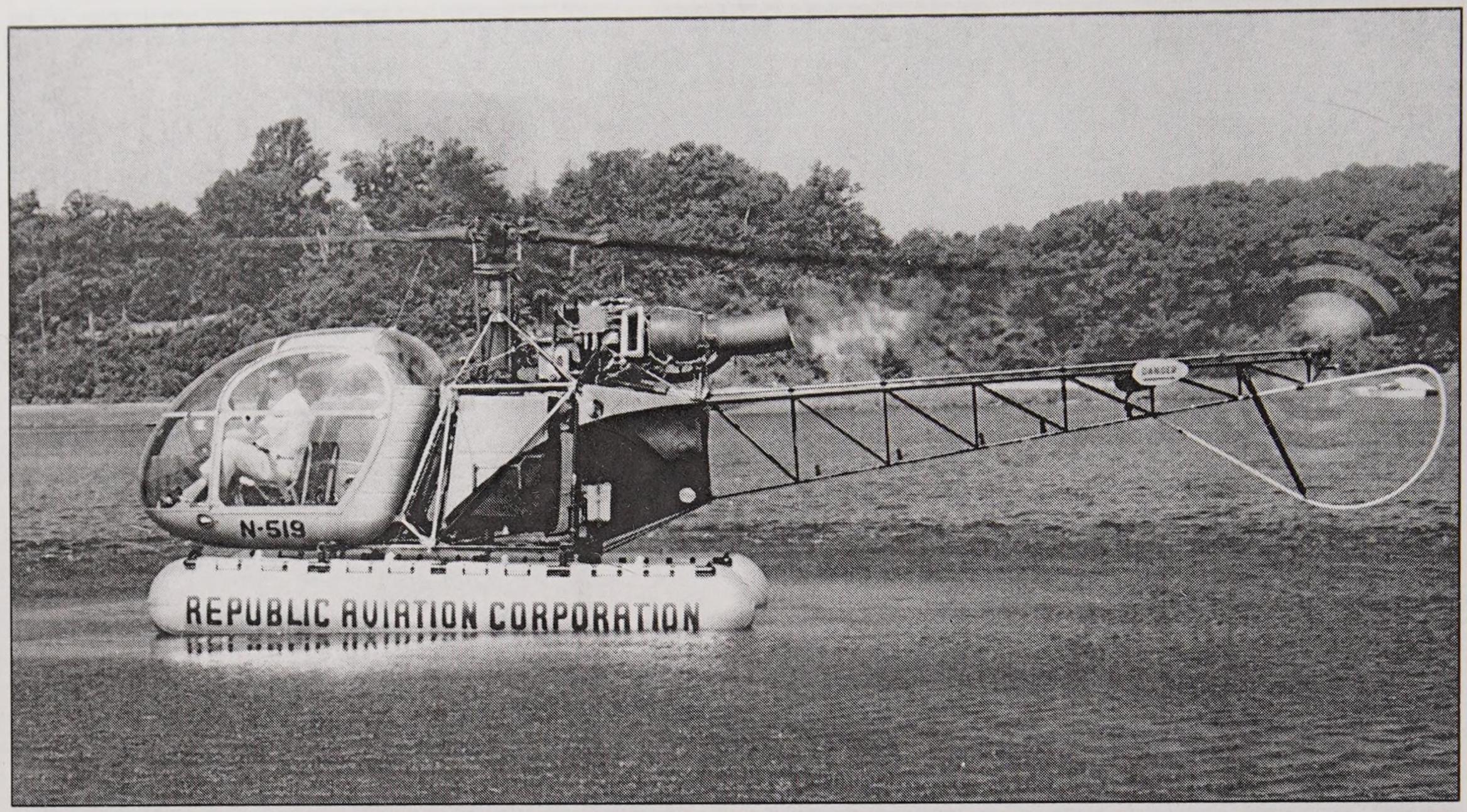
EPILOGUE

The world's fastest four-engine piston-powered aircraft first flew as a proud symbol of America's aviation prowess in the years following World War II. And yet, for all of its advanced performance and improved military capability to rapidly acquire and process critical photographic intelligence imagery, the airplane proved that it takes more than operational success to guarantee a lucrative government production contract. Had this elegant aircraft flown at a different time, politically and economically, it could have been a legend.

Helicopters to the Rescue

With the exception of 1,063 RC-3 Seabee amphibians, no other commercial airplanes were ever mass produced by the Republic Aviation Corporation. (Twenty-five Sud Alouette II turbine-powered light utility helicopters were built at Farmingdale from 1958 to 1960. However, they were only manufactured under license to the French aircraft company that had designed it.) A grand total of 8,716 jet fighters were built at Farmingdale from 1946 to 1965 when Republic was bought by Fairchild in September of that year. When combined with P-43, P-47, and Seabee production numbers, plus the 716 A-10 Thunderbolt II attack aircraft first built by Fairchild Republic in 1972, a grand total of more than 26,000 airplanes rolled out the door of Republic's final assembly building.

For Howard Hughes, loss of the contract to place the XF-11 into production signaled the end of his

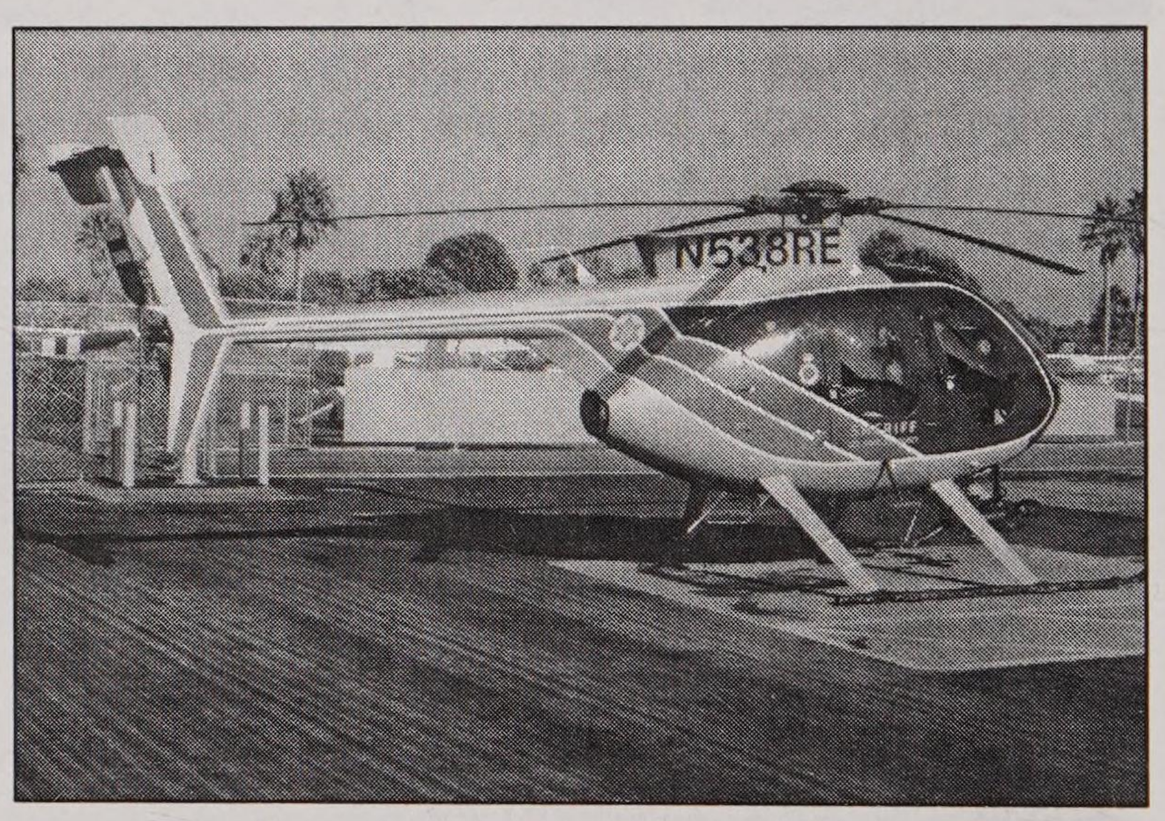


Other than the RC-3 Seabee amphibian, the only commercial aircraft manufactured by the Republic Aviation Corporation was the French Sud Aviation SE 3130 Alouette II, the world's first production turbine-powered helicopter, and the first turbine-powered helicopter certified for commercial operation in the United States. Capable of flying at a cruising speed of 110 mph over a 350-mile range, the revolutionary Alouette II set the world altitude record for helicopters in June 1958, reaching a height of 36,501 feet near Paris. Twenty-five of the five-seat Alouettes were built under license at Farmingdale from 1958 to 1960. (Republic via Author Collection)

company's days of manufacturing fixed-wing aircraft of any type. As good as they may have been for their respective missions, Hughes' cadre of flying machines were now relegated to being only exotic, avant-garde, one-of-a-kind prototypes such as the H-1 racer, HK-1 Hercules flying boat, XF-11 photo airplane, and XH-17 experimental cargo "sky crane" helicopter. Hughes' aviation empire then turned its corporate energies into creating a highly successful series of light utility helicopters, air-to-air missiles, radar guidance systems, and advanced electronics systems eventually to include communication satellites. In later years, components of the Hughes Aircraft Company and Hughes Space & Communications were bought by McDonnell Douglas, Raytheon, and Boeing.

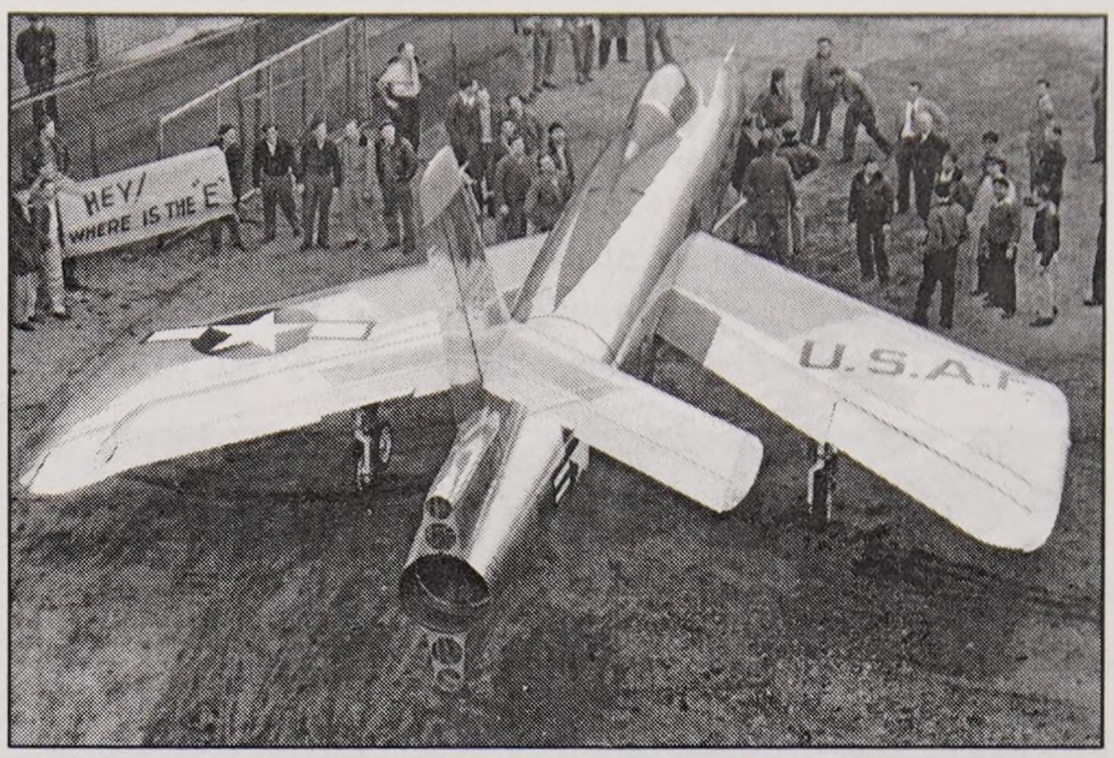
A Thunderous Sound of Fighter Jets

After the legendary P-47, only the F-84 Thunder-jet, F-84F Thunderstreak, RF-84F Thunderflash, and F-105 Thunderchief composed Republic's proud lineage of production-line aircraft. Nearly 9,000 jet fighters were built by Republic from the end of World War II until the company was bought by the Fairchild Corporation in 1965. From 1966 to the company's demise in October 1987, only one other successful Air Force aircraft rolled

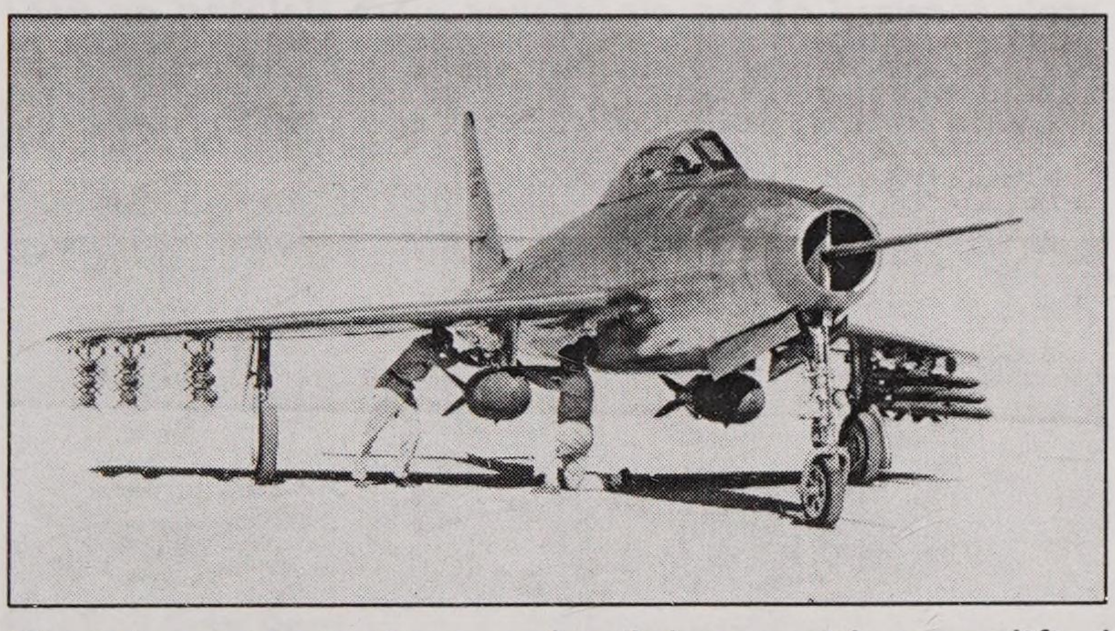


Despite having created one-of-a-kind airplanes such as a record-setting racer, mammoth troop transport, photo-recon ship, and giant cargo-carrying helicopter, the only mass-produced aircraft ultimately built by the Hughes Aircraft Company was a highly successful line of light utility helicopters. Beginning with the piston-powered three-place 300 series, Hughes Helicopter grew in stature with the more advanced turbine-powered 500 line. These five-place helicopters gained fame with the U.S. Army during the Vietnam War, and then evolved into the 500E seen here. This helicopter was operated by the Los Angeles County Sheriff's Department. (Mike Machat)

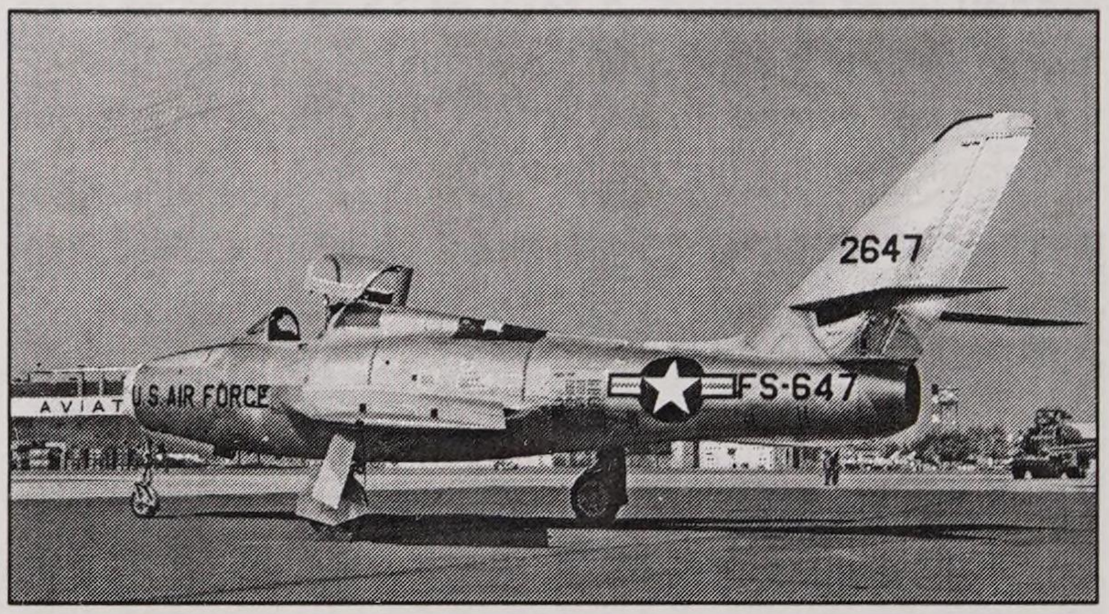
The F-84 Thunderjet was Republic's first jet-powered aircraft. It served as the backbone of the Air Force's fighter-bomber assets during the Korean War and exhibited remarkable survivability in combat. Powered by a single 5,600-pound-thrust Allison J35 engine, the F-84 was capable of 620-mph top speeds and had a combat range of 870 miles. The F-84G model, shown here with Republic's newly painted Building 17 in the background, was the first production jet fighter equipped for aerial refueling, and was also the first Air Force fighter officially designated to carry an atomic bomb. In today's military environment where jet fighter production units are counted in the low hundreds, a seemingly unbelievable number of 4,457 straight-wing Thunderjets were built. (Author Collection)



The world's first jet-powered aircraft to attain supersonic speed in level flight, the XF-91 was developed for an Air Force advanced interceptor competition that was won by the Convair F-102 Delta Dagger. Employing inversely tapered wings that could alter their angle-of-incidence in flight, the XF-91 represented Republic's first foray into the world of high-performance jet-powered flight. Two prototypes were built and were tested with such modifications as a V-shaped butterfly tail, large nose radome, and two-barrel Reaction Motors XLR-11 rocket engine mounted in the tail. Although never placed into production, the XF-91 paved the way for Republic's Advanced Project 63, which evolved into the F-105. (G. Hildebrand via Author Collection)



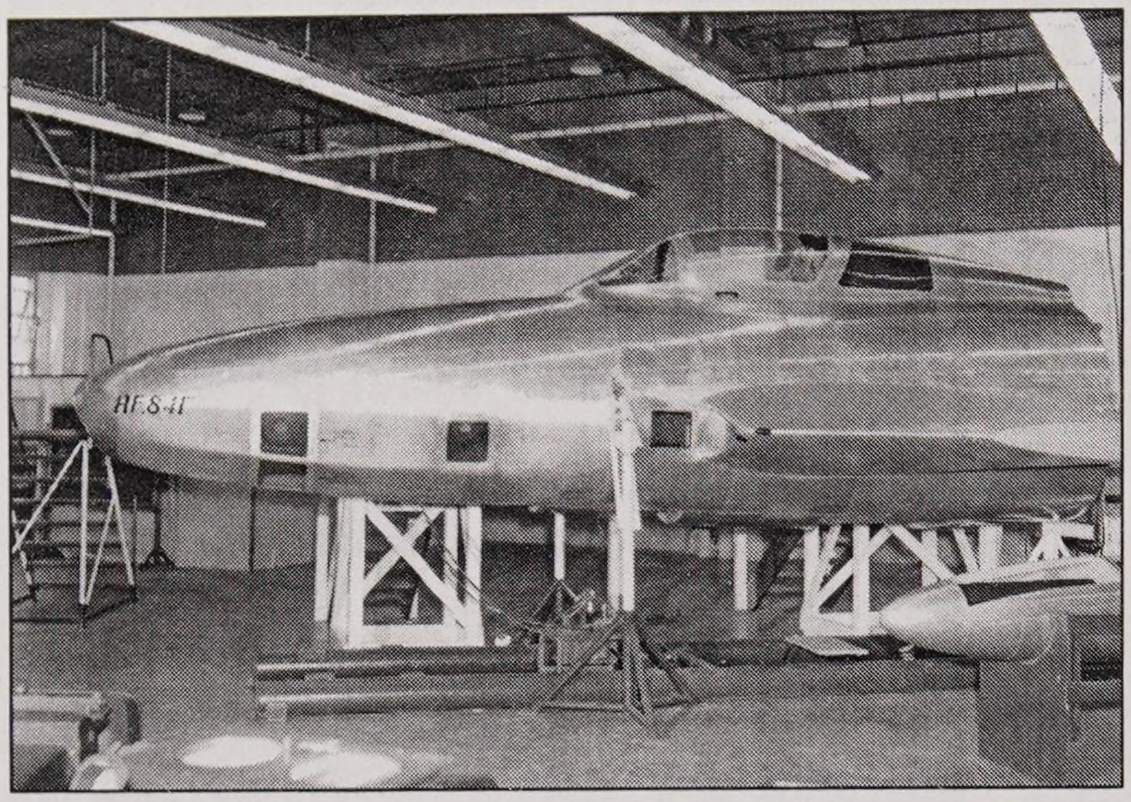
Marrying swept wings and tailplanes with a modified F-84 fuselage resulted in a much more modern-looking aircraft with higher performance as well. The YF-96A is shown here on Rogers Dry Lake at Edwards AFB, California, in late 1950 fitted with six racks of 5-inch high-velocity aerial rockets, and two dummy 1,000-pound bombs. The aircraft sported a unique cockpit canopy and windshield design, with its V-shaped windscreen containing an integral gunsight design also used on the XF-91. The Republic test pilot making the YF-96A's inaugural flight was Oscar "Bud" Haas who also commanded the first flight of the second XF-12 in August 1947. The F-96 designation was abandoned because of lack of funding for a new aircraft type, and this design evolved into the F-84F. (Republic via Author Collection)



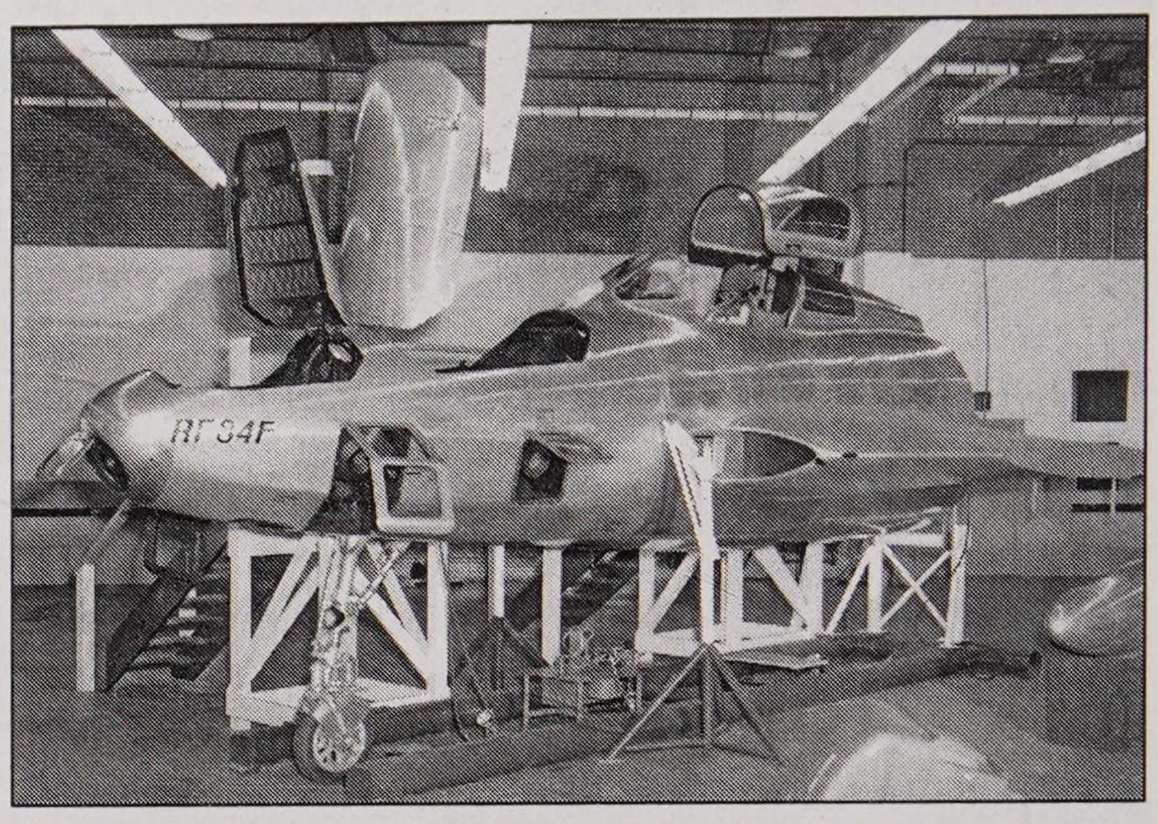
The F-84F was Republic's first swept-wing production aircraft. Gaining worldwide fame being flown by the U.S. Air Force Thunderbirds Aerial Demonstration Team in the mid 1950s, the F-84F also held the official U.S. transcontinental speed record in 1955, having covered 2,445 miles from Los Angeles to New York in just 3 hours and 44 minutes. Flown by the U.S. Air National Guard and many NATO nations, the F-84F served as a rugged fighter-bomber throughout the early years of the Cold War. Powered by a 7,200-pound-thrust Allison J65 turbojet, the F-84F could carry a wide variety of armament including rockets, napalm, fragmentation bombs, and nuclear weapons. A total of 2,711 Thunderstreaks were built, the longest production run of any swept-wing Republic aircraft. (G. Hildebrand via Author Collection)

out of Building 17 at Farmingdale. Having won an Air Force fly-off competition against Northrop's A-9, the tank-busting Fairchild Republic A-10 Thunderbolt II entered development in 1972 and is still in service to this day. Many young Republic engineers and assembly workers who'd begun their careers on the P-47 ended their days at Fairchild Republic on the A-10. In a final bit of irony, the A-10 (better known in Air Force circles as the Warthog) is supported for the Air Force today by Northrop Grumman.

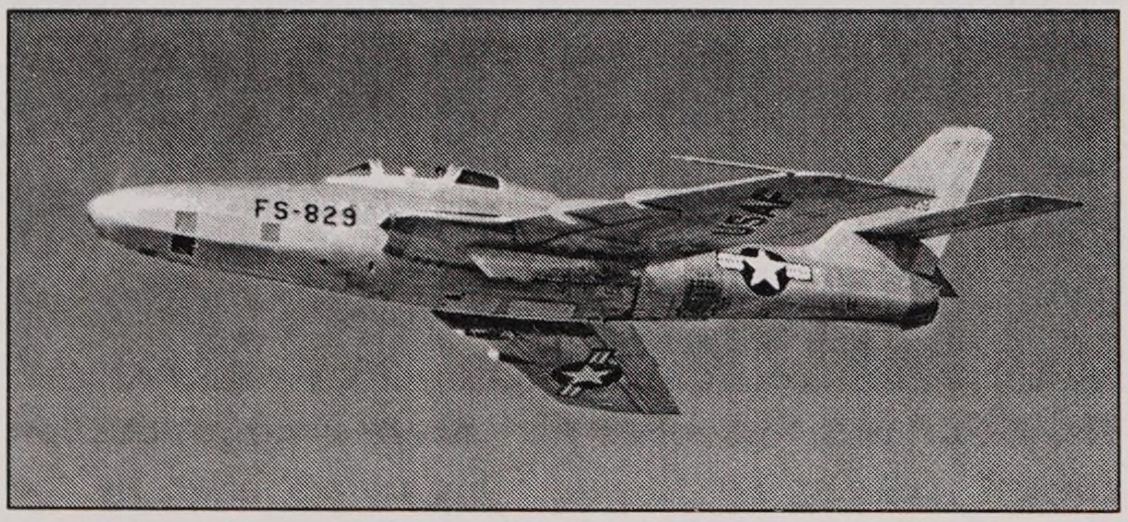
Despite the fact that the XR-12 never flew in operational military service, in a sense the airplane paved the way for all high-speed, high-altitude, long-range photo-recon aircraft that followed. Having a dedicated high-



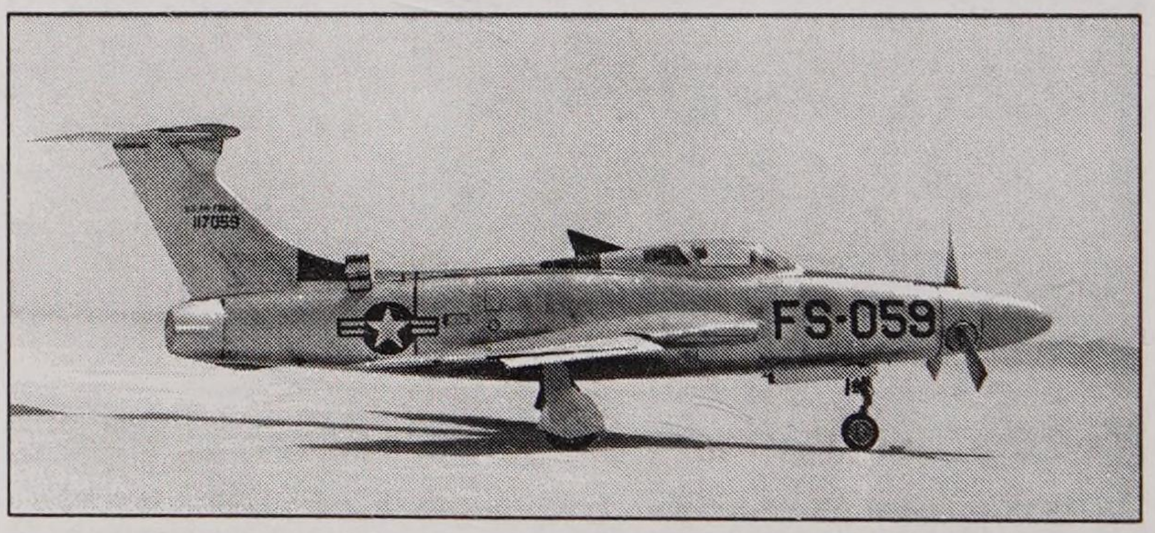
The first photograph showing the development mockup of a photo-recon camera nose configuration grafted onto the front of an F-84F Thunderstreak. Replacing that aircraft's identifiable nose air intake were two wing-root-mounted intakes that fed air into the aircraft's Allison J65 engine, but the cockpit and the F-84F's novel cantilevered upward-swinging canopy were retained. A total of 15 cameras of varying sizes and types could be carried by the RF-84F, which was named quite aptly, the Thunderflash. (G. Hildebrand via Author Collection)



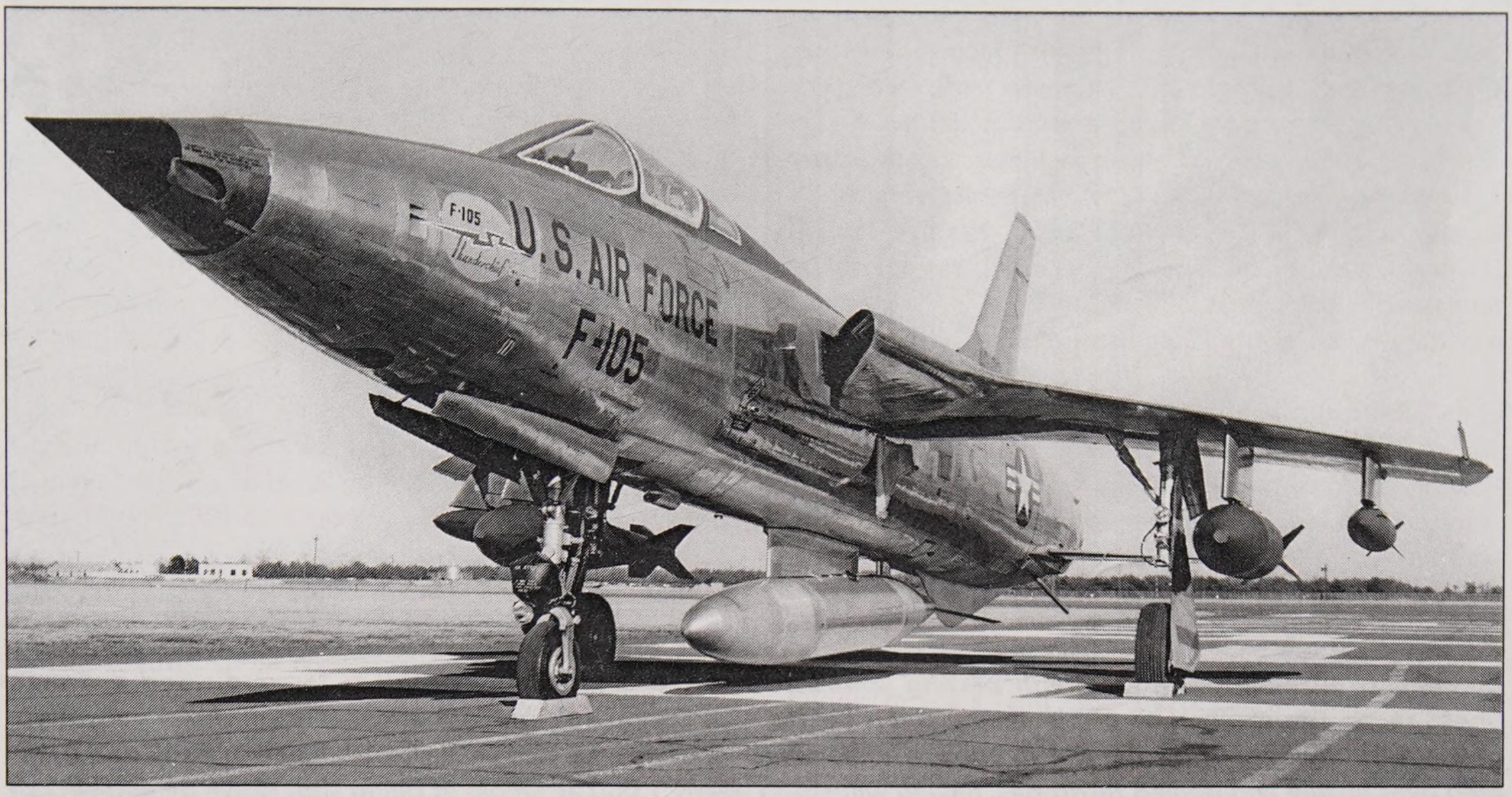
Demonstrating ample accessibility to the RF-84F's multiple camera bays, the mock-up is shown here with the nose landing gear lowered and all eight access panels and camera windows in the full open position for ground servicing. Note small floodlight visible on the rear bulkhead of the forward nose compartment for night operations. Square camera windows immediately forward of the air intakes were deleted on production airplanes. Wooden steps on the right side allowed for inspection of cockpit and camera bays. (G. Hildebrand via Author Collection)



Perhaps the most successful variant of the F-84F Thunderstreak was the RF-84F Thunderflash photo-reconnaissance jet, which first flew in February 1952. Widely used by the U.S. Air Force and many NATO countries, RF-84Fs won the first annual NATO Photo-Reconnaissance Competition held in Europe in October 1956. Armed with four .50-caliber machine guns, the RF-84F had a top speed of nearly 700 mph with a service ceiling in excess of 45,000 feet. The transonic Thunderflash was also tested as an experimental parasite fighter to be carried in the bomb bay of a Convair B-36 during studies for the FICON (Fighter Conveyance) Program. A total of 715 RF-84Fs were built. (G. Hildebrand via Author Collection)

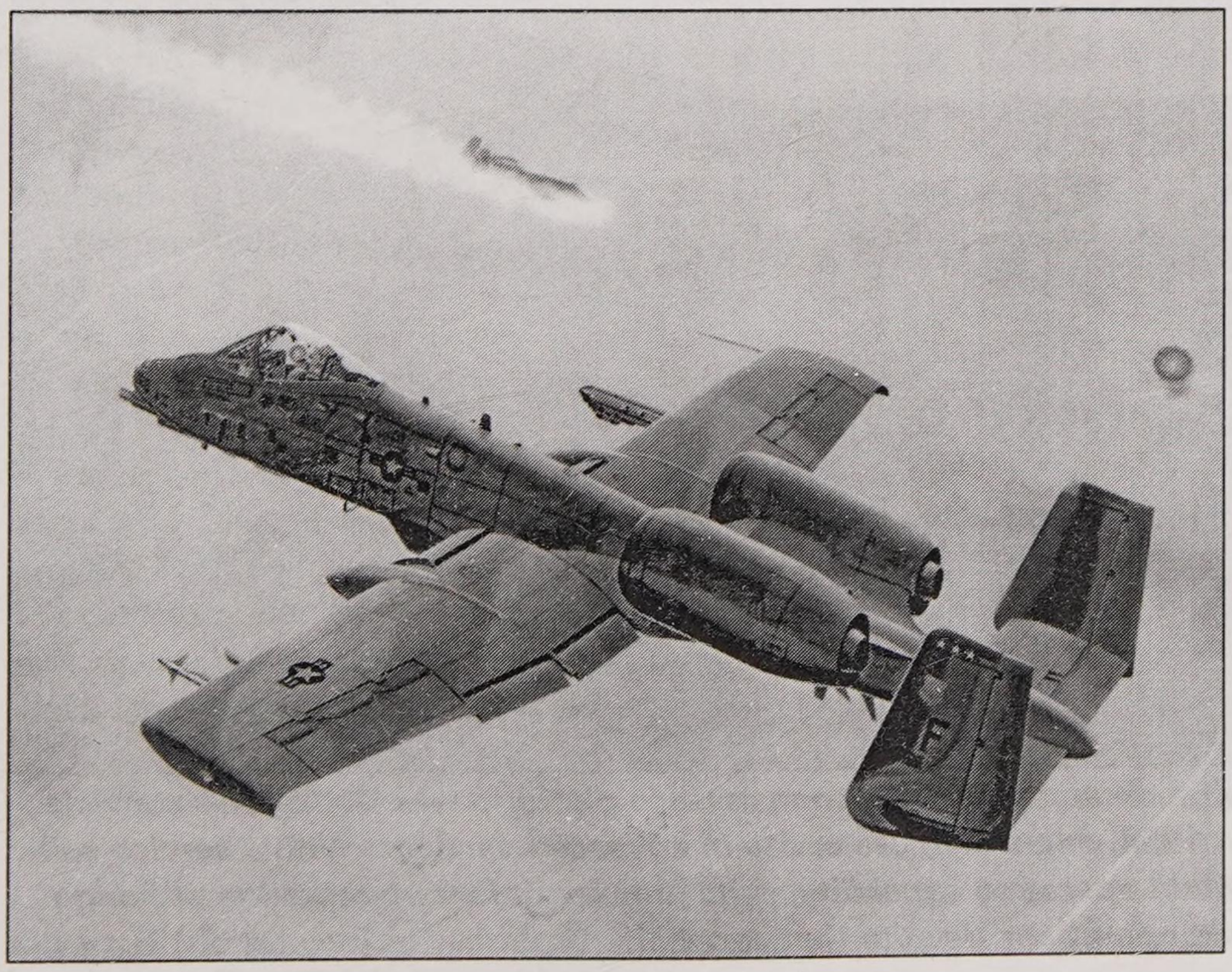


Perhaps the epitome of the "build it, fly it, and see if it works, or not" mentality of the postwar American aviation industry was the futuristic looking, but woefully underperforming XF-84H. Nicknamed the "Thunderscreech" because of the overwhelming noise emanating from its three stub propeller blades turning at supersonic speed, the XF-84H was yet another unsuccessful attempt at harnessing the power of an Allison T40-geared turboprop engine and then combining it with a sleek aerodynamic airframe. Only two of these aircraft were built, and their flight test program was short-lived. (AFFTC History Office via Tony Landis)

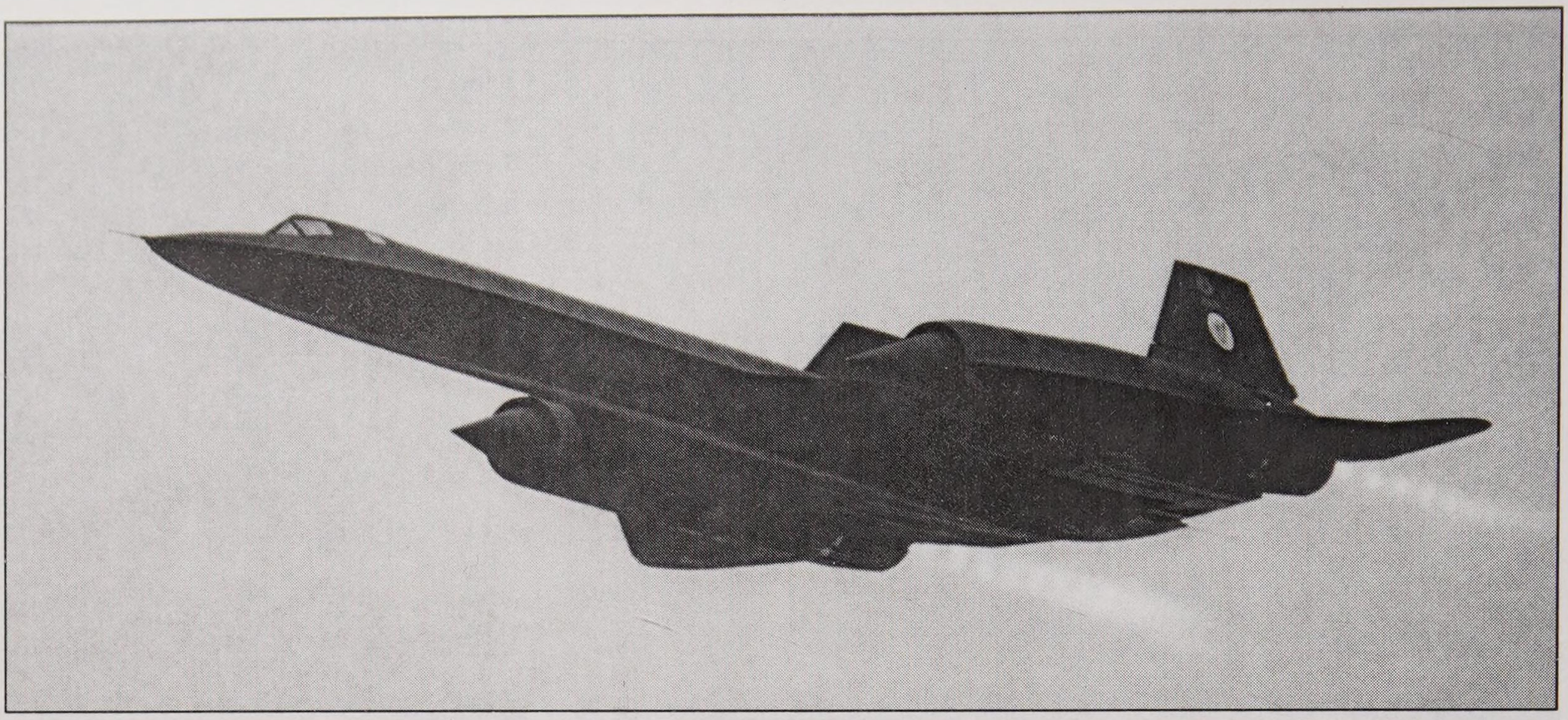


The last jet fighter built by Republic was the legendary F-105 Thunderchief, the world's largest and heaviest single-engine, single-seat aircraft. Despite its bogus F-105 buzz number, this airplane is actually YF-105B FH-102 (S/N 54-0102), the third pre-production development aircraft, and the first Thunderchief to be flown from Republic's runways. (Republic via Author Collection)

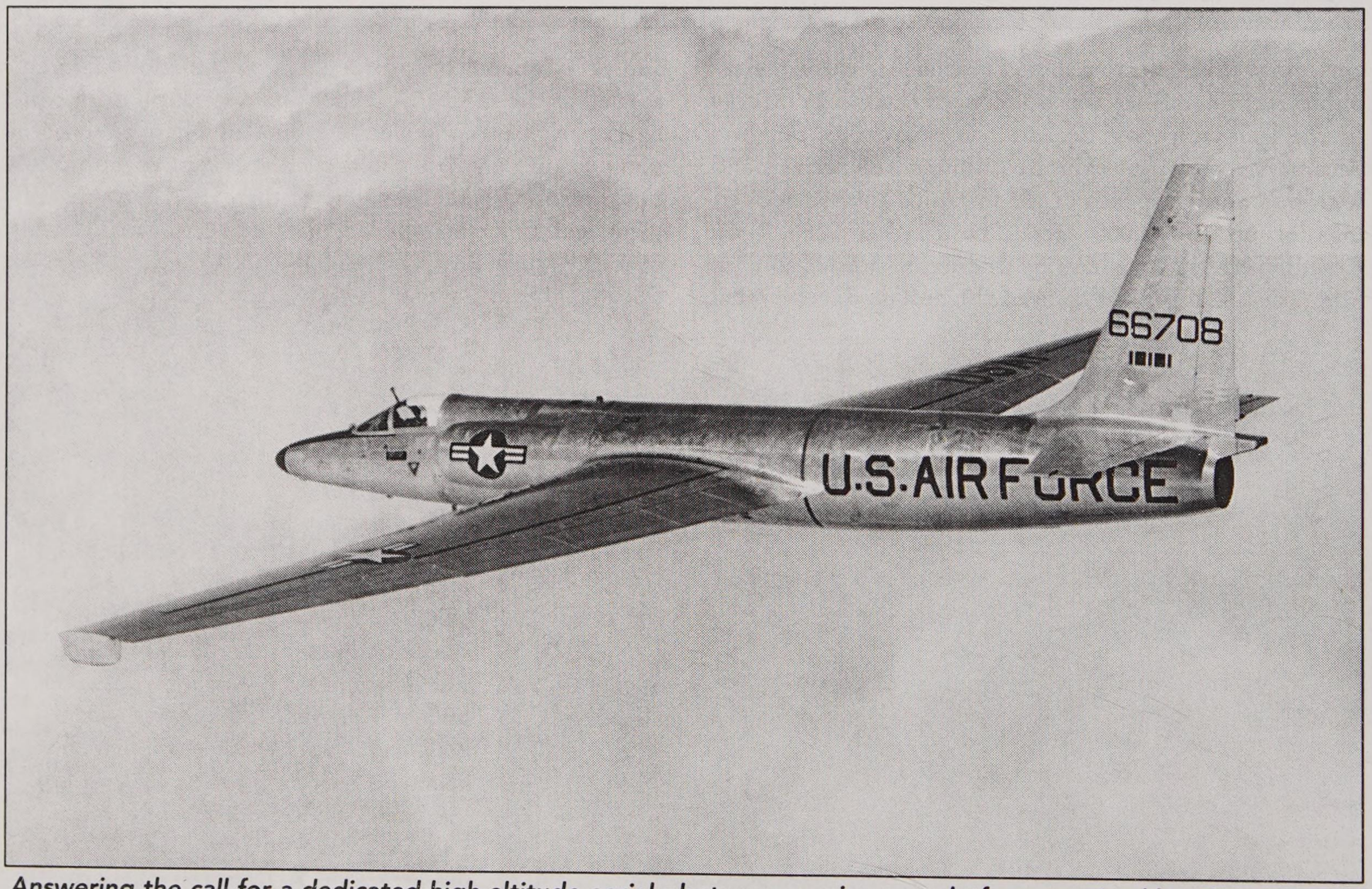
performance aircraft to conduct intelligence gathering and photo reconnaissance was quite a novel concept in 1944. In the following two decades, such airplanes not only became a reality, but exhibited unheard-of performance with operational speeds of Mach 3-plus and service ceilings of up to 90,000 feet. The Hughes XF-11 and Republic XR-12 may have never entered production, but both aircraft deeply influenced the design, development, and procurement of future "dedicated mission" aircraft, as well as the means by which their aerial photo-reconnaissance operations were conducted. That influence is manifest in some of today's most advanced aircraft—both manned and unmanned—that are flying intelligence-gathering and photo-reconnaissance missions all over the world, and high above what used to be popularly referred to as "denied territory."



Although the A-10 Thunderbolt II was produced by Fairchild Republic from 1975 to 1984, it is included here because it was built literally in the same final assembly building as its namesake more than three decades earlier. This painting depicts the Warthog's first air-to-air kill, which occurred on 6 February 1991 during the Gulf War. Air Force Capt. Jon Engle is shown directing the strike as the attacking A-10 in the background shoots down two Iraqi Sud SA-319 Alouette III helicopters. A total of 716 A-10s were built. (Mike Machat)



Combining ultra-high altitudes with blazing speed solved the vulnerability problem for dedicated unarmed photo-recon aircraft, and no airplane ever did it better than Lockheed's brilliant SR-71 Blackbird. An outgrowth of the A-12 developed for the CIA in 1962, the Blackbird went into service with the Air Force in 1965 and operated over hostile and denied territories, having withstood nearly 1,000 attempts at being shot down by anti-aircraft missiles. A total of 32 SR-71s were built, and those that remain are proudly preserved for posterity in aviation museums, for none were ever scrapped after the type made its final flight in 1999. The SR-71 will always be the world's fastest and highest-flying operational manned aircraft. (Tony Landis Photo)



Answering the call for a dedicated high-altitude aerial-photo-reconnaissance platform was Lockheed's stalwart and super-secret U-2 design, first flown in 1954, and still in use today in advanced versions. With a service ceiling of 70,000 feet, the U-2 used high-altitude operating capability as its primary defensive measure, although several of these aircraft were lost in hostile operations despite that capability. (Courtesy of Tony Landis)

Advanced Recon Missions — Lockheed U-2 and SR-71

Although the ERB-47H served admirably in the 1950s, it wasn't until 1956 that Lockheed's Advanced Design Company, better known as the "Skunk Works," produced the world's first dedicated high-altitude photo-reconnaissance aircraft. Developed initially for the Central Intelligence Agency, the U-2 (a dubious designation indicating that it was the second in a series of "utility" aircraft) first took to the skies from a secret Lockheed test site in the remote Nevada desert called Groom Lake. Essentially a long-winged jet motorglider, the U-2 was capable of flying at altitudes of up to 70,000 feet, and at that height, was thought to be impervious to attack by anti-aircraft missiles. That was until 1 May 1960. On that fateful day, CIA pilot Francis Gary Powers, flying a U-2 deep into the Soviet Union, was shot down over the city of Sverdlovsk by a Russian SA-2 Guideline surface-to-air missile (SAM). In an embarrassing political incident, the U-2 was shown to be just as vulnerable as any other military airplane after all.

As capable as the U-2 may have been for high-altitude photo-reconnaissance up until that point, it wasn't until 1964 that the Air Force finally received its long-awaited high-speed, high-altitude, dedicated-mission reconnaissance aircraft, the incomparable Lockheed SR-71 Blackbird. Not only was this high-flying and ultra-fast aircraft designed specifically for the highly classified recon and ELINT mission, but with its Mach 3.2 cruising speed and 90,000-foot service ceiling, the Blackbird became the world's highest-performance operational aircraft. Able to obtain imagery of 100,000 square miles in one hour of flight time, the SR-71 served as the backbone of the Air Force's intelligence-gathering fleet from 1965 until it was retired in 1997. It is estimated that nearly 1,000 attempts were made to shoot it down, but none ever came close. With the words "manned," "winged," and "air-breathing" now forever associated with the accomplishments of this incredible airplane, it is safe to say there will never again be a flying machine capable of attaining this stunning level of performance.

More importantly, there will never again be the *need* for a manned flying machine capable of attaining this level of performance. Why? Because, with stealth technology, flying an aircraft at high speed and high altitude are no longer mandatory requirements as means for survival. With the advent of autonomous unmanned aerial vehicles, there is no longer even a need for a pilot to be onboard the aircraft. With digital electronics, the need for such primitive devices as film canisters, chemistry-based photo labs, and legions of photo interpreters working around-the-clock has also become a thing of the past.

Satellite Intelligence

As the world learned with the U-2 shoot-down, advanced Soviet anti-aircraft weaponry negated the advantage of ultra-high-altitude capability as a suitable defensive measure for photo-recon and surveillance aircraft. With the coming of the space age, however, it was only a natural evolution of the state of the art to adapt earth-orbiting satellites to the aerial reconnaissance role. The highly classified Project Corona, the world's first IMINT (Image INTelligence) satellite, was developed exclusively to observe the Soviet Union from space, and became operational with the CIA in 1960. This system remained an effective intelligence information-gathering source as late as 1972.

Using the name "Discoverer" for the public, these satellites were launched into orbit by Douglas Thor IRBMs (Intermediate-Range Ballistic Missiles) and took photographic images from space that could be retrieved in film canisters recovered from the satellites. After their fiery re-entry into the Earth's atmosphere, the film canisters were caught in midair by special boom- and grappling-hook-equipped twin-engine Fairchild C-119 Flying Boxcars (and later by larger four-engine turboprop Lockheed C-130 Hercules transports) over the Pacific Ocean. These film canisters, the first objects ever recovered from space, were then flown directly to processing centers for immediate analysis and interpretation. This was an astonishing leap in technology, considering that it came only three short years after Sputnik I was first shot into orbit.

Now downloaded through secure digital data links at the speed of light, satellite imagery has come a long way since the primitive use of airborne film canister retrieval. Although cloud cover was an impediment to photographic mission effectiveness in the early days, infra-red and other "all-seeing" sensing measures have raised today's satellite capability to impressive levels. Thus, the clear advantage of satellite surveillance is its complete and utter impunity. Although "anti-satellite" weaponry was something first seen by the public in James Bond films or read about in Tom Clancy novels, that technology has existed for decades. Today, even foreign countries such as China have demonstrated the capability to destroy alien satellites in orbit. However, compared to the relatively high risks of ground fire at low altitude, or missile attack at high altitude, surveillance satellites remain relatively impervious to enemy attack.

Global Hawk

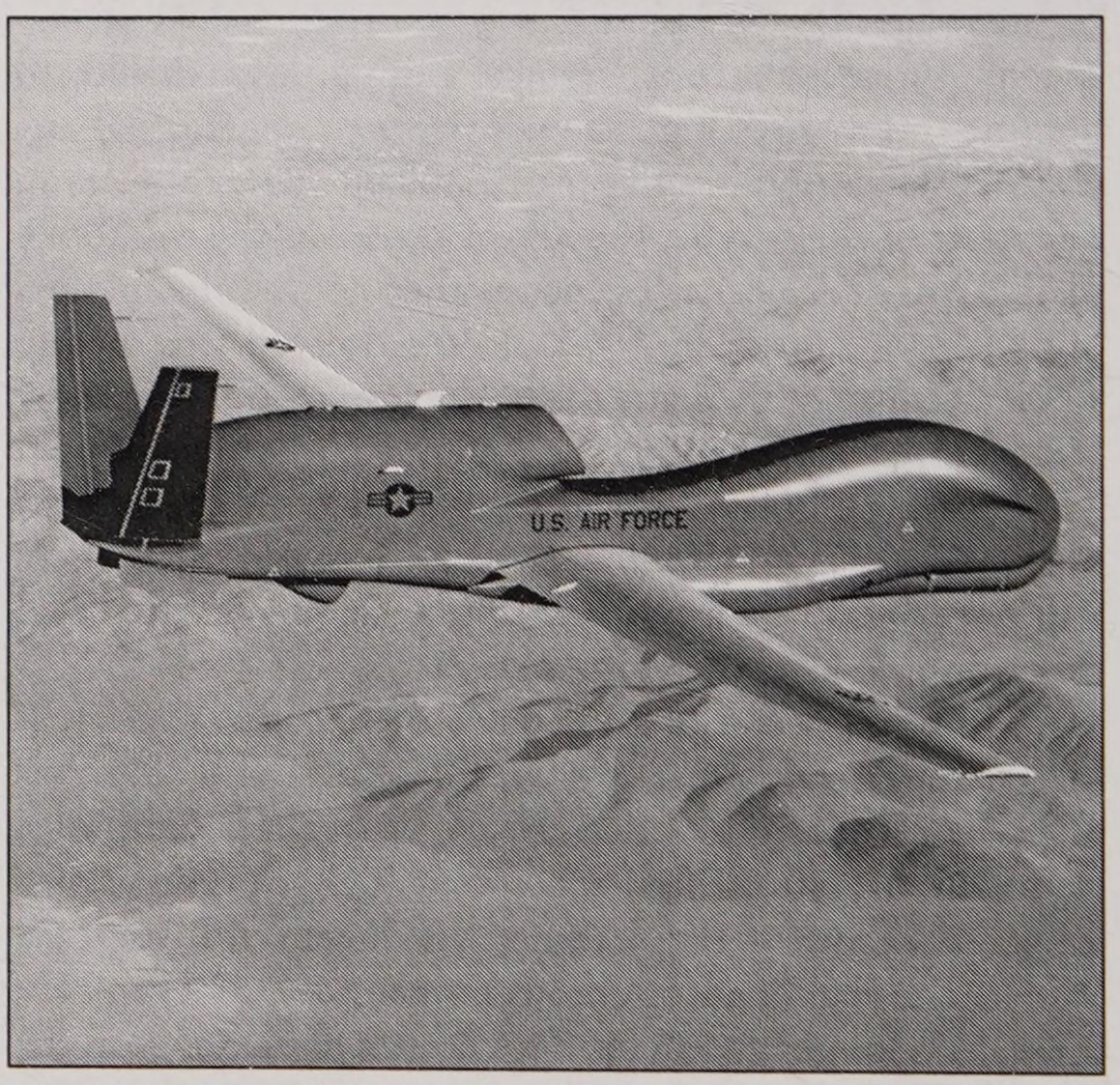
Although various unmanned combat aircraft have been used by the U.S. military for more than 90 years, none have been as successful for high-altitude surveillance as Northrop Grumman's RQ-4 Global Hawk. As the world's first fully autonomous unmanned aircraft (meaning it is not actively flown by a pilot sitting at a ground station as with the Predator), the evolution of the RQ-4 high-altitude long-endurance (HALE) aerial reconnaissance and surveillance system has continued the company's long-standing unorthodox approach to aircraft

A fitting image to end the story of the Republic XR-12 Rainbow is this portrait of Alexander de Seversky who built one of the world's first aircraft to fly faster than 300 mph in 1939. The count is seen here sitting in the cockpit of the then-brand-new North American X-15 rocketplane in 1959. The X-15 flew at speeds as fast as Mach 6.7 (4,250 mph) and at altitudes above 350,000 feet. Famed North American project pilot A. Scott Crossfield is leaning into the cockpit at left. (Cradle of Aviation Museum Archives)

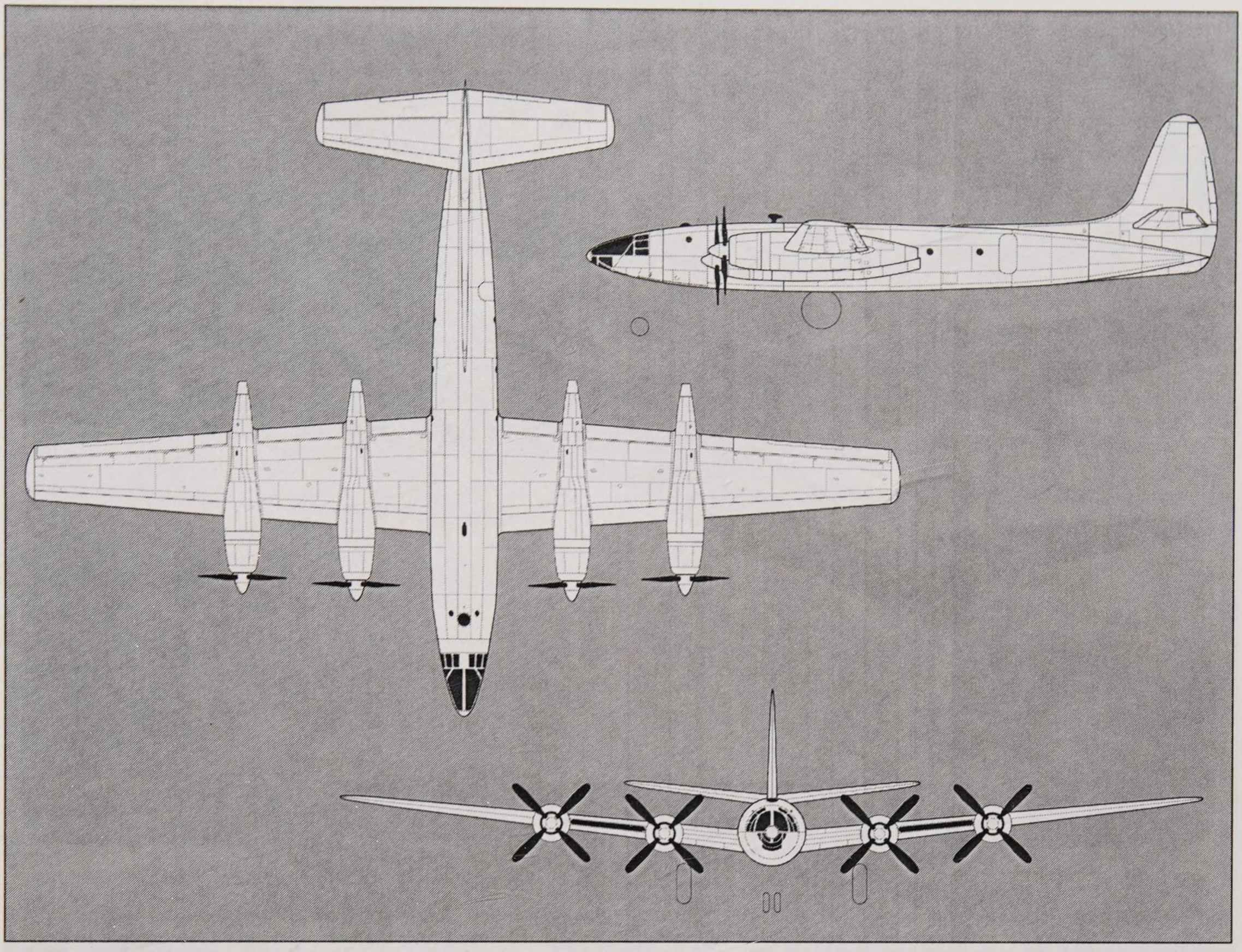
development dating back to Jack Northrop's first flying wings. It was recently revealed that the prototype RQ-4 was actually deployed on a "live" combat mission while still undergoing its initial flight tests. There are currently five major RQ-4 design variants, plus the NASA Hawk, NATO Hawk, and Euro Hawk all being developed by Northrop Grumman.

Taking the concept of airborne surveillance, photo reconnaissance, and battlefield control to an entirely new level, the Global Hawk is literally changing the way warfare is being waged on the front lines as well as in the skies. The latest Airborne Warning and Control Version of the Global Hawk is essentially a high-flying Internet provider allowing warfighters in the field to directly contact the aircraft, and then download real-time digital imagery of enemy positions and troop movements from 60,000 feet to their field computers in just seconds.

This new capability not only eliminates the customary lag time in battlefield communications, but also negates the need for dedicated photo interpretation. Furthermore, upon visually identifying enemy threats from imagery relayed by the Global Hawk, calls for close air support can be relayed from the ground through the aircraft directly to airborne strike forces already on station. This process saves precious time (not to mention lives) by bypassing complicated military communications links, and helps deliver badly needed ordnance directly to enemy targets quickly and with unmatched precision—all without a pilot in the cockpit.



Representing the zenith of contemporary unmanned aerial surveillance and intelligence-gathering platforms is the Northrop Grumman RQ-4 Global Hawk, currently in use with U.S. and foreign air forces, as well as in varied civilian applications. Capable of long-endurance missions measured in days instead of hours, Global Hawk brings capabilities to the modern warfighter that were undreamed of even 10 years ago. (USAF via Tony Landis)



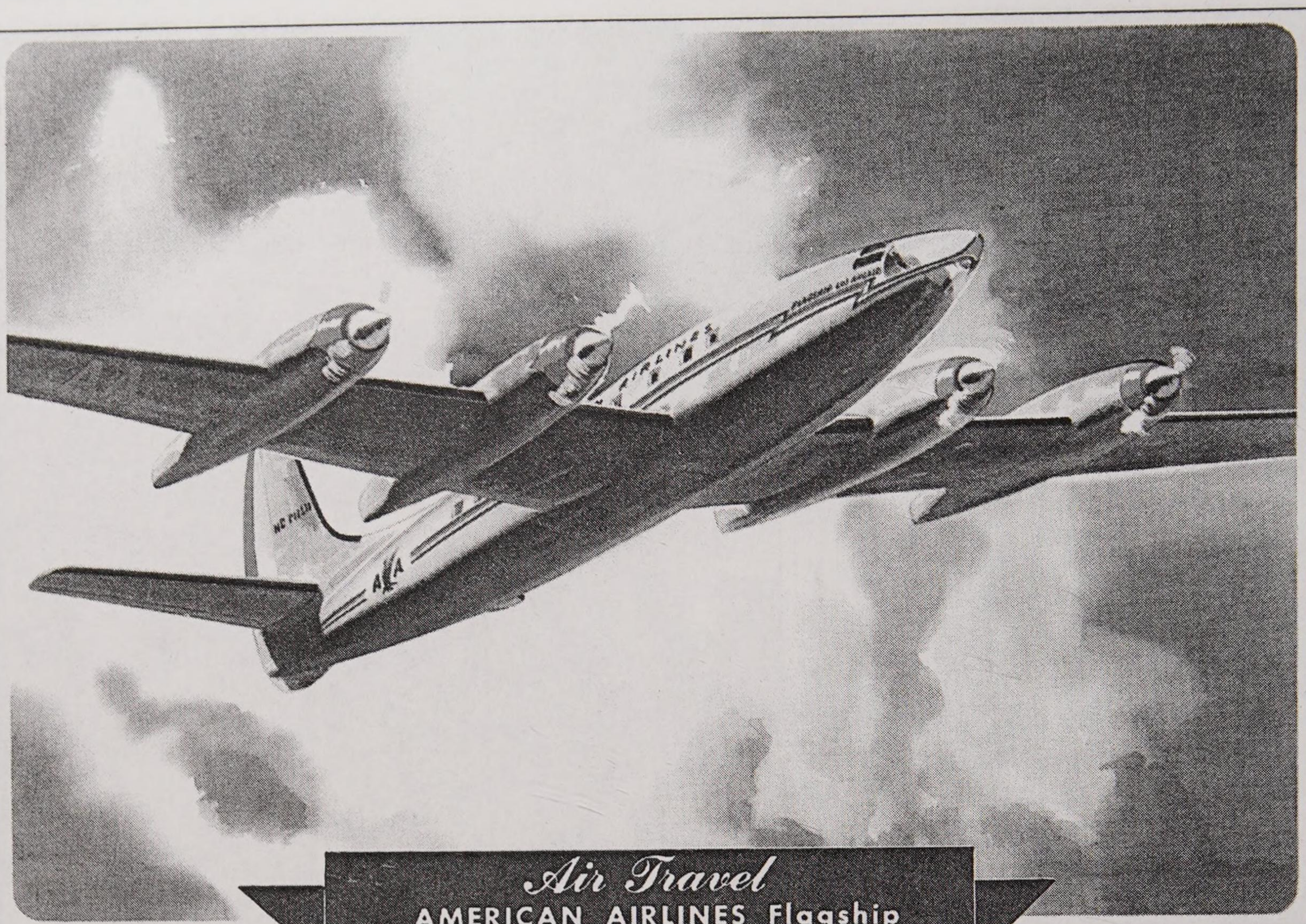
Three-view drawing of the four-engine Republic XF-12. (Digital Illustration by Tony Landis)

The XR-12 Rainbow's Legacy

What all of the aforementioned advanced aircraft and systems have in common is that they exist today, or existed generations ago, for only one important purpose: to gather and deliver critical information to military commanders and their analysis personnel as soon as possible. That information, whether photographic or electronic, is used by those commanders to assist in making sometimes critical tactical decisions. These decisions could not only spell defeat for an enemy, but could mean the difference between life and death for American fighting men and women on the front lines of the world's battlefields.

As for the Rainbow's commercial airline aspirations, that airplane would have offered greatly improved performance for an entirely new generation of air travelers in 1948. Having had that airplane in operational service almost a full decade before America's first-generation jetliners entered commercial service would also have guaranteed instant success for any commercial air carrier fortunate enough to have been flying such a machine, costly or not.

In that regard, despite the fact that the Republic XR-12 Rainbow never went into production as either a high-performance photo-recon platform or advanced high-performance airliner, the proud legacy of this futuristic aircraft still lives on in every new military or commercial airplane created to meet a specific mission requirement, and that pushes the envelope of aviation progress today.



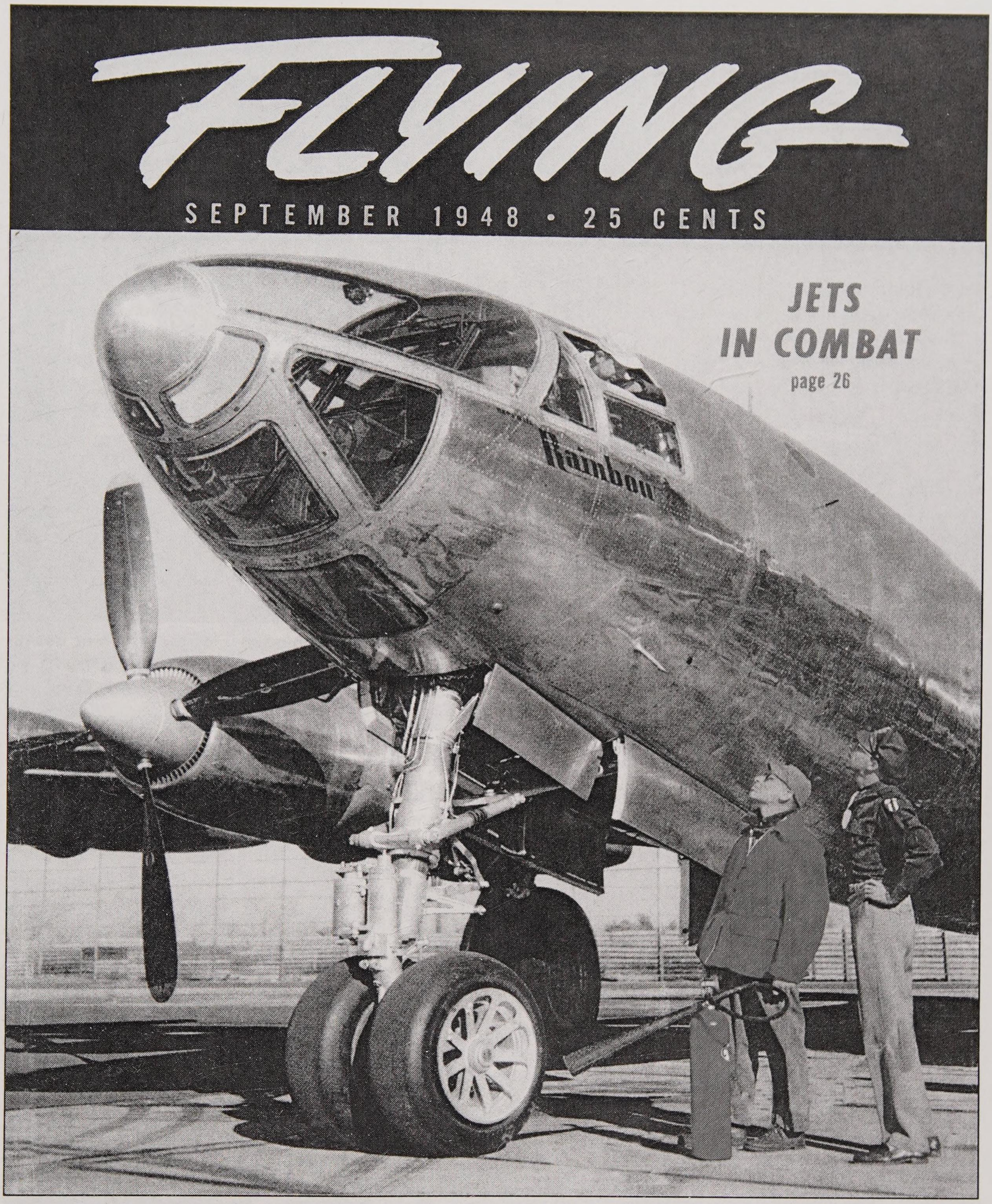
RAINBOW LOUNGE FOR GAMES, LETTER WRITING, ETC.

THE RAINBOW FLAGSHIP CARRIES 42 PASSENGERS AT 420 M.P.H.

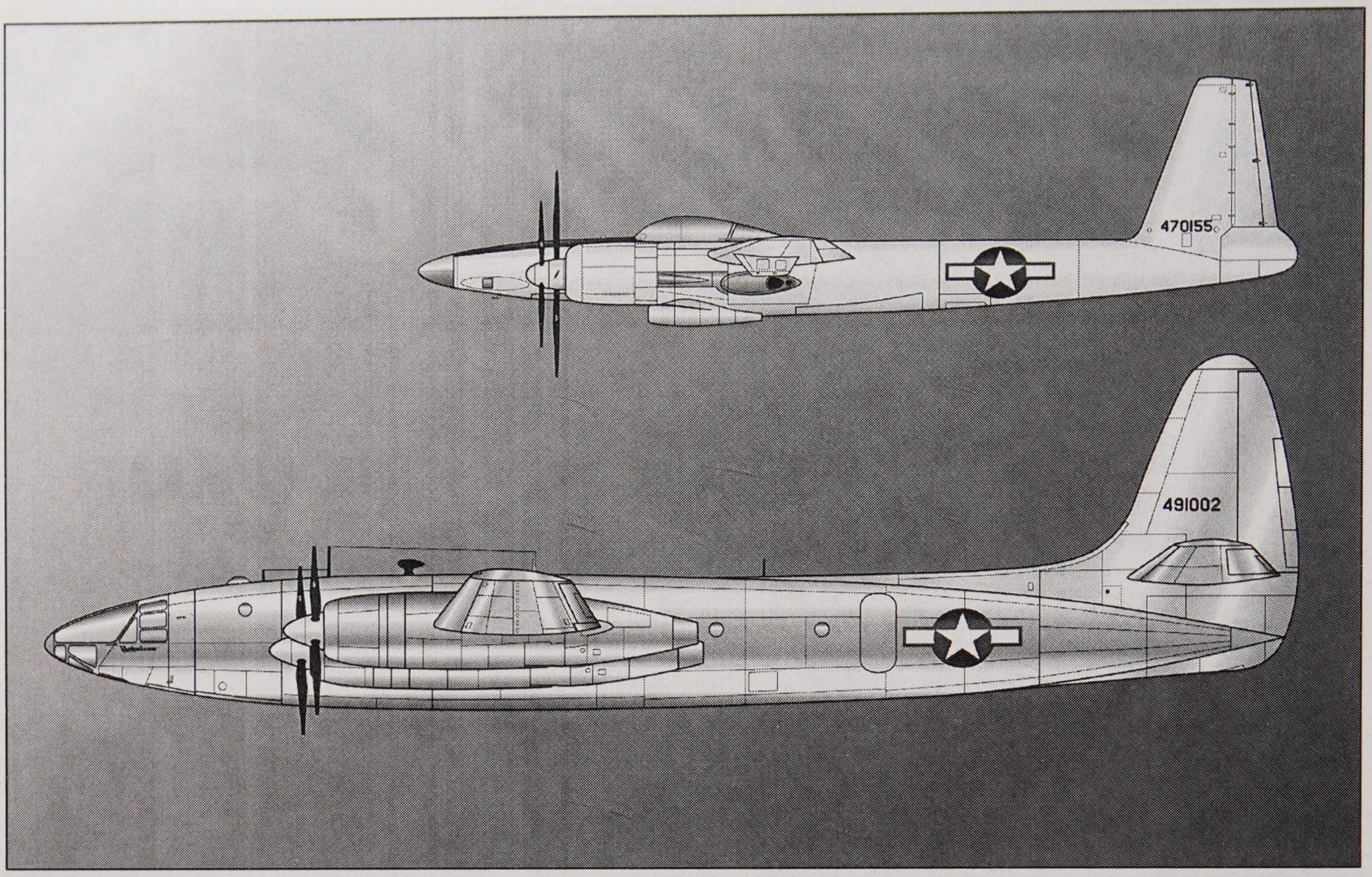
THIS WORLD'S FASTEST AIRLINER FLIES FROM COAST-TO-COAST IN SEVEN HOURS

HOT MEALS SERVED FROM AN ELECTRIC GALLEY

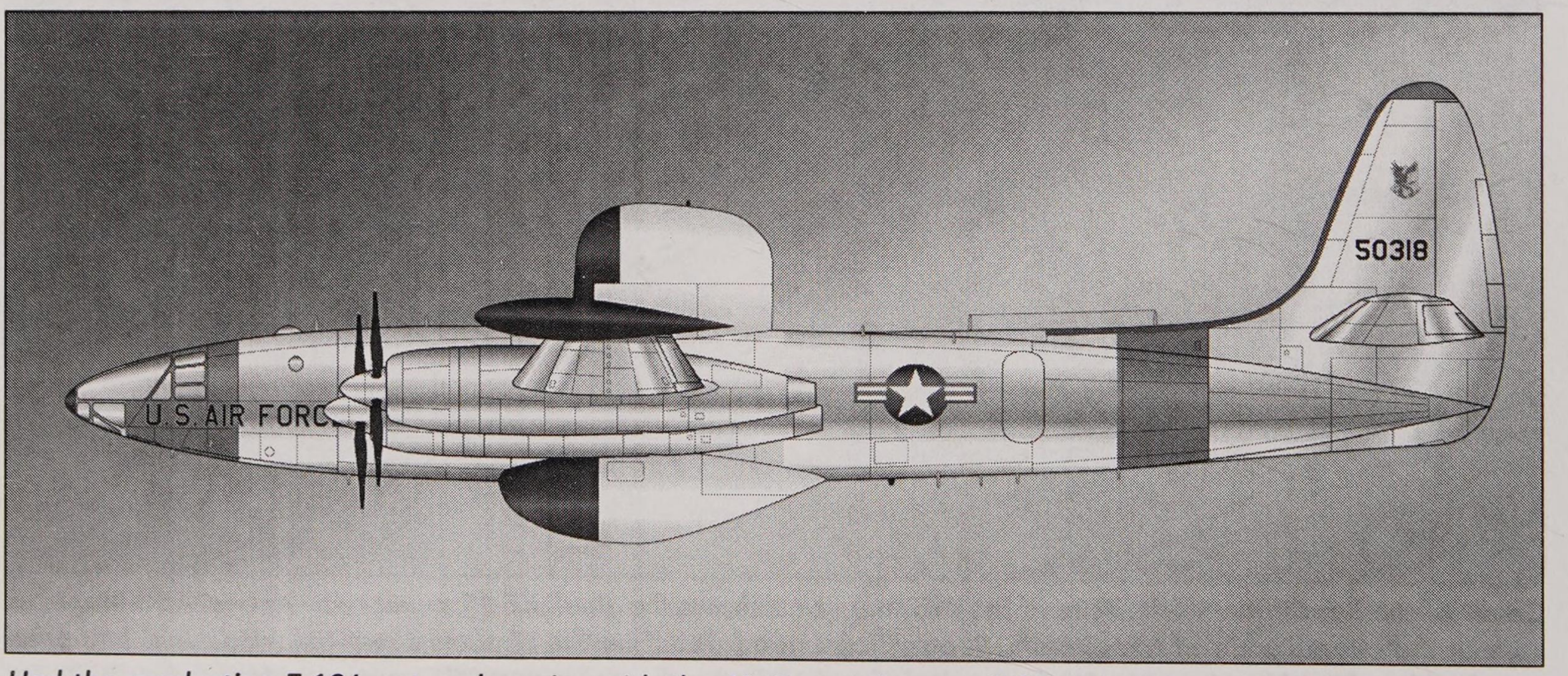
Dramatic display advertisement captures all the speed, luxury, and elegance of Republic's RC-2 as it would have appeared in commercial operation with American Airlines as a "Rainbow Flagship." As was typical of all aircraft interior renderings of this genre, the cabin is depicted at about twice the size of the aircraft's actual internal dimensions. American's international subsidiary, American Overseas Airlines, would have conceivably used the RC-2 Rainbow on many of its long-range routes between gateway cities in the United States and destinations throughout Europe. American had 25 RC-2s on order when the military XF-12 was canceled. (Craig Kodera Collection)



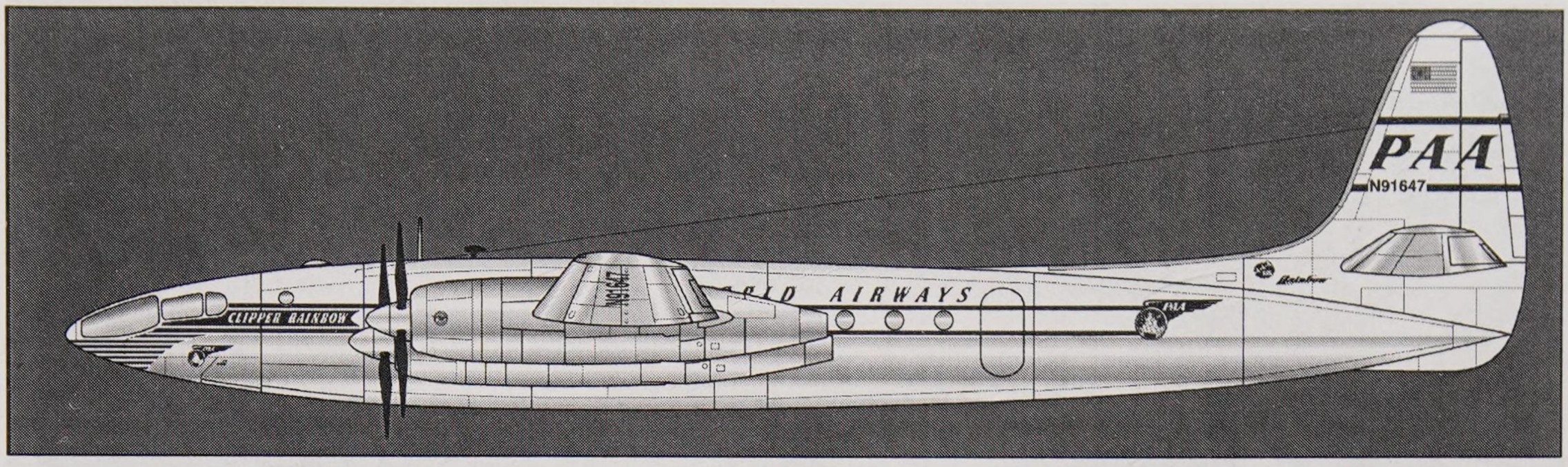
Cover of the September 1948 issue of* FLYING *magazine shows the sleek XF-12 bullet nose to best advantage, as well as the overall scale of the aircraft. Photo shows good detail on the airplane's internal windshield and pressure bulkhead, with separate instrument panels for the pilot and co-pilot providing optimum forward visibility for both crewmembers. Note wet compass mounted on the center windshield frame and the impeller fan blades visible inside the engine cowling. Magazine headline at upper right is "JETS IN COMBAT"—a most prophetic statement considering the ultimate fate of the XF-12 program. (Photo by Harold G. Martin Courtesy of John K. Lewis)



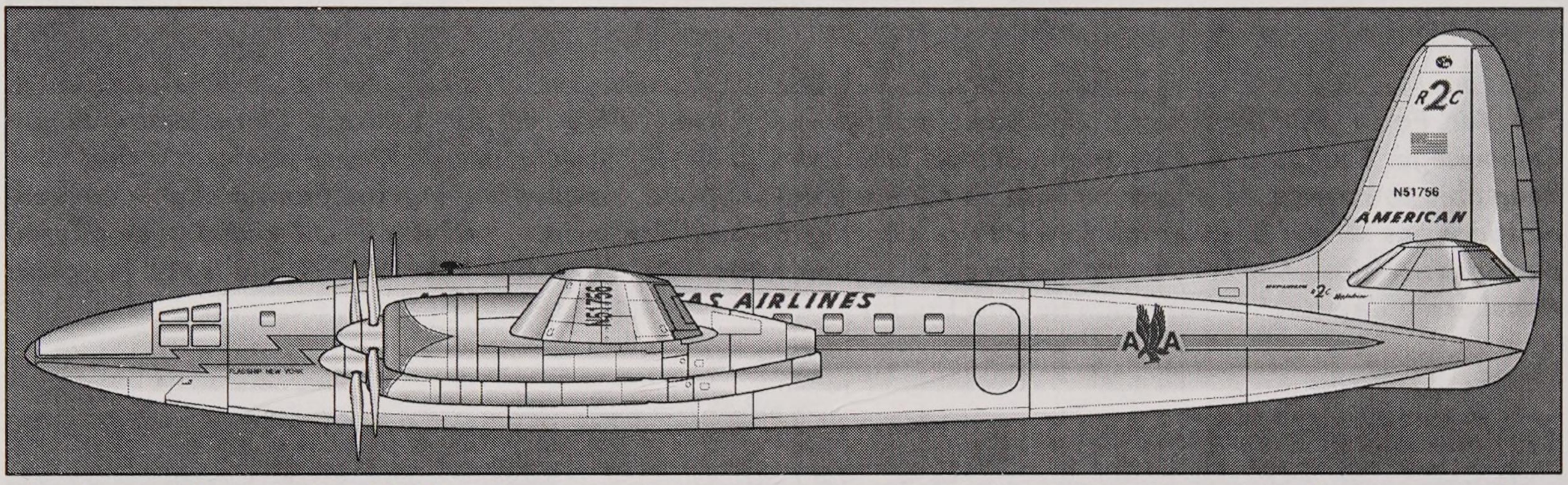
Size comparison of Hughes XF-11 and Republic XF-12 profiles gives a graphic sense of the different design philosophies between the two airplanes. Reminiscent of the Boeing YC-14 and McDonnell Douglas YC-15 Air Force AMST (Advanced Medium STOL Transport) fly-off competition in the late 1970s, one company proposed a rather non-conventional twin-engine aircraft (XF-11/YC-14) while the other put forward a more traditional four-engine design (XF-12/YC-15). Considering that the Air Force selected the YC-15 and its time-honored four-engine configuration to become that service's new heavy airlifter (the McDonnell Douglas C-17 Globemaster III), would that same ideology have applied to a new photo-recon aircraft some 40 years earlier? (Digital Illustration by Tony Landis)



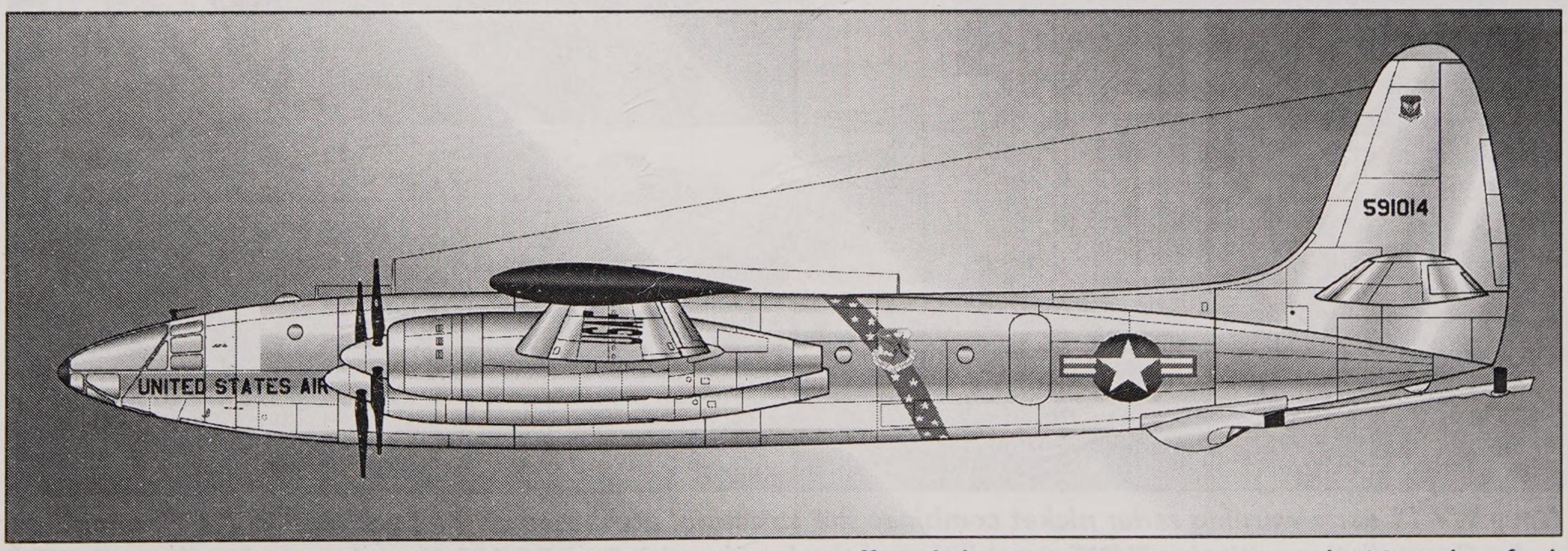
Had the production F-12A entered service with the Air Force, the possibilities for its use in carry-over missions would have been endless. Sporting the distinctive upper and lower radomes of the Lockheed EC-121 Constellation, here we see the U. S. Air Force's Republic EC-12 radar picket complete with early 1960s striping and external fuel tanks mounted on the wingtips. (Digital Illustration by Tony Landis)



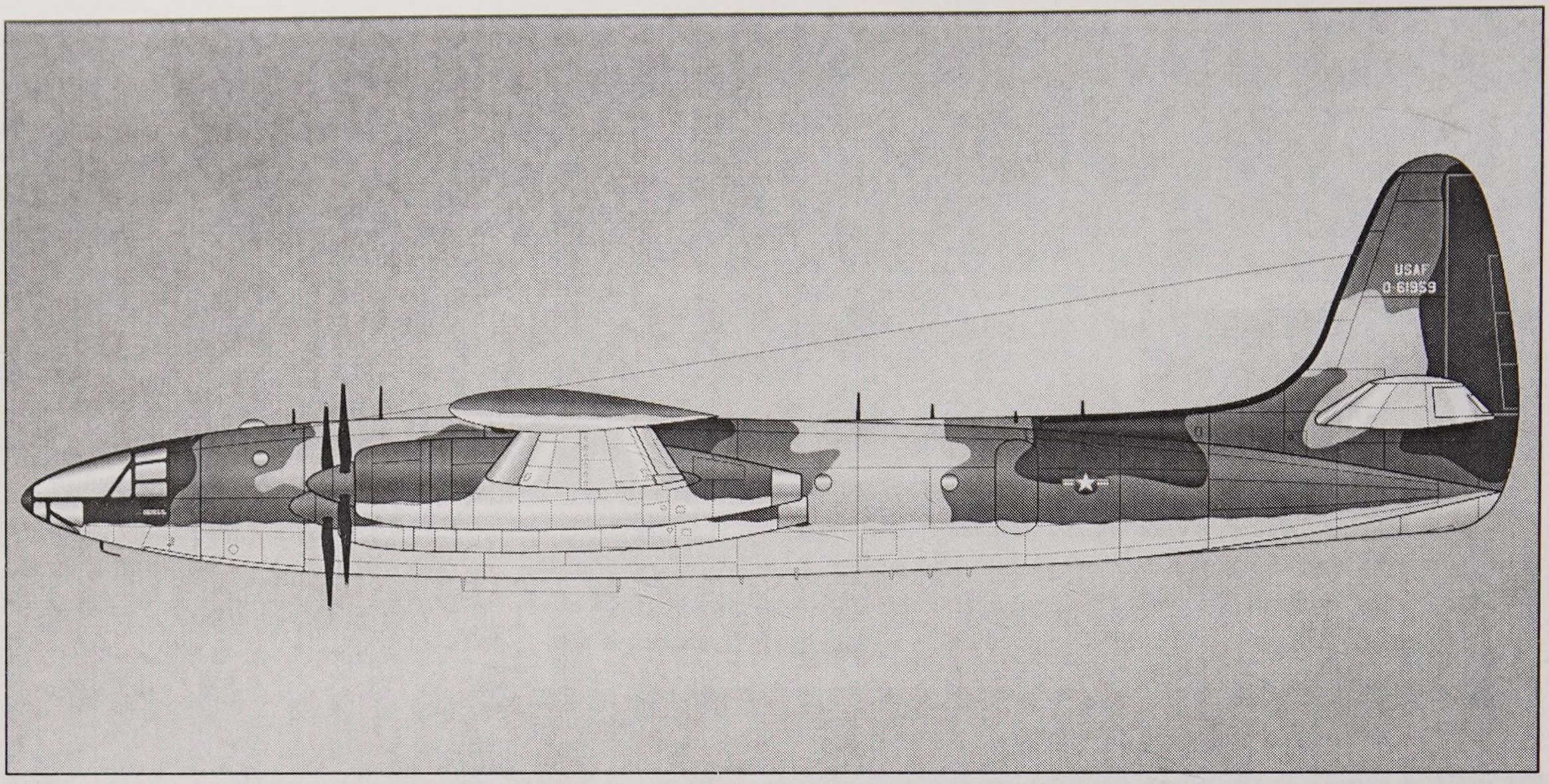
RC-2 profile shows the aircraft wearing Pan American World Airways markings, circa 1953, as designed for use on the Douglas DC-6B. The "white crown" fuselage motif served two distinctly different functions. The white paint augmented cooling of the cabin interior in warm weather, and aided inflight aircraft identification by denoting it as a civilian airliner versus an all-metal military aircraft. This feature became especially important with the growing specter of aerial attack on the United States during the Cold War. (Digital Illustration by Tony Landis)



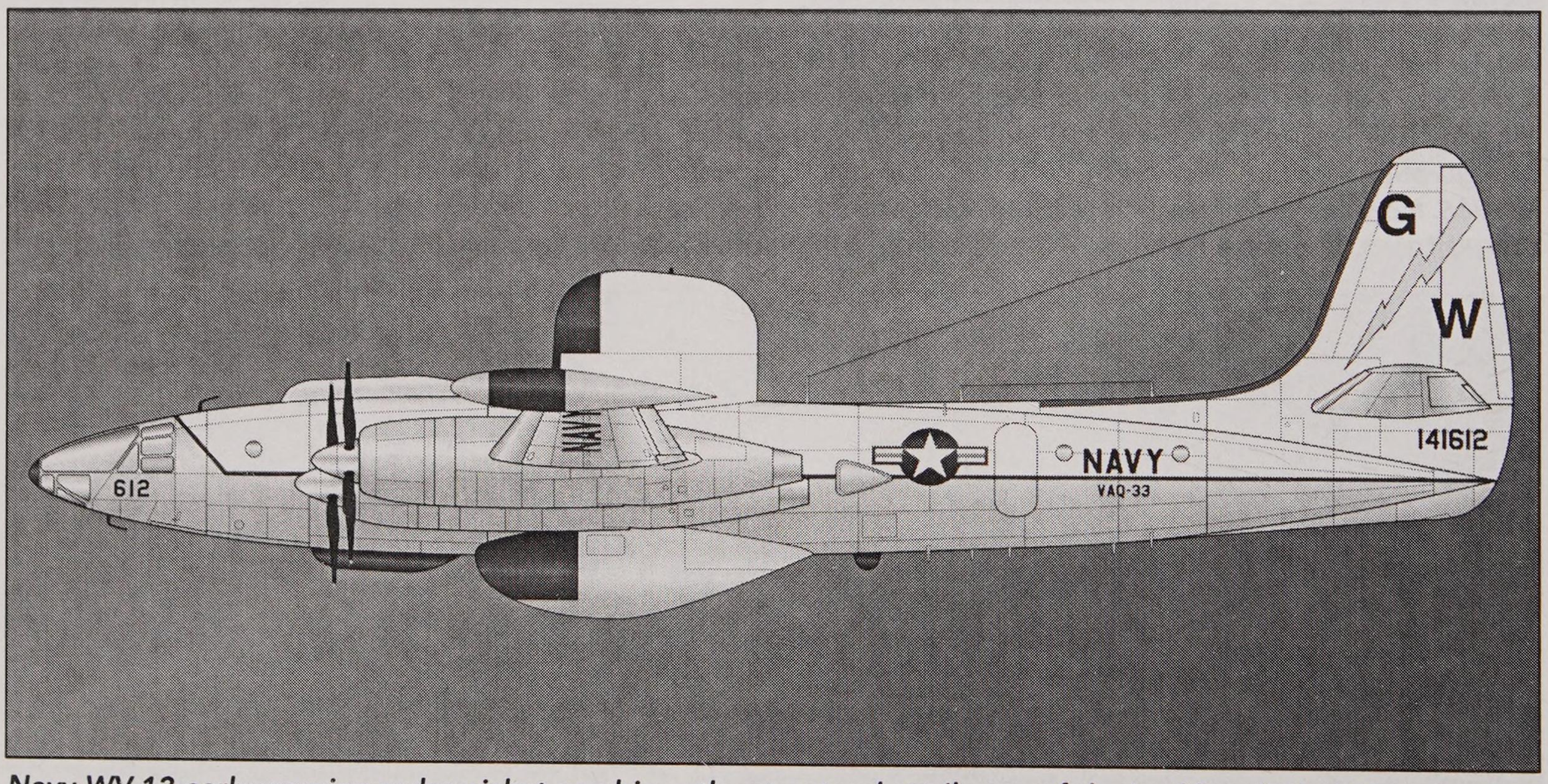
Showing a different windshield and cockpit window arrangement, this illustration depicts the RC-2 in operational American Airlines markings, circa 1954, as used on that carrier's Douglas DC-7 Flagships. This nose and window configuration was first seen on the RC-2 mockup built by Republic for showing prospective airlines its new airliner in 1946. Note the use of larger, square passenger windows similar to those seen on the DC-7, Lockheed 1049 Super Constellation, and certain versions of the Boeing Stratocruiser. (Digital Illustration by Tony Landis)



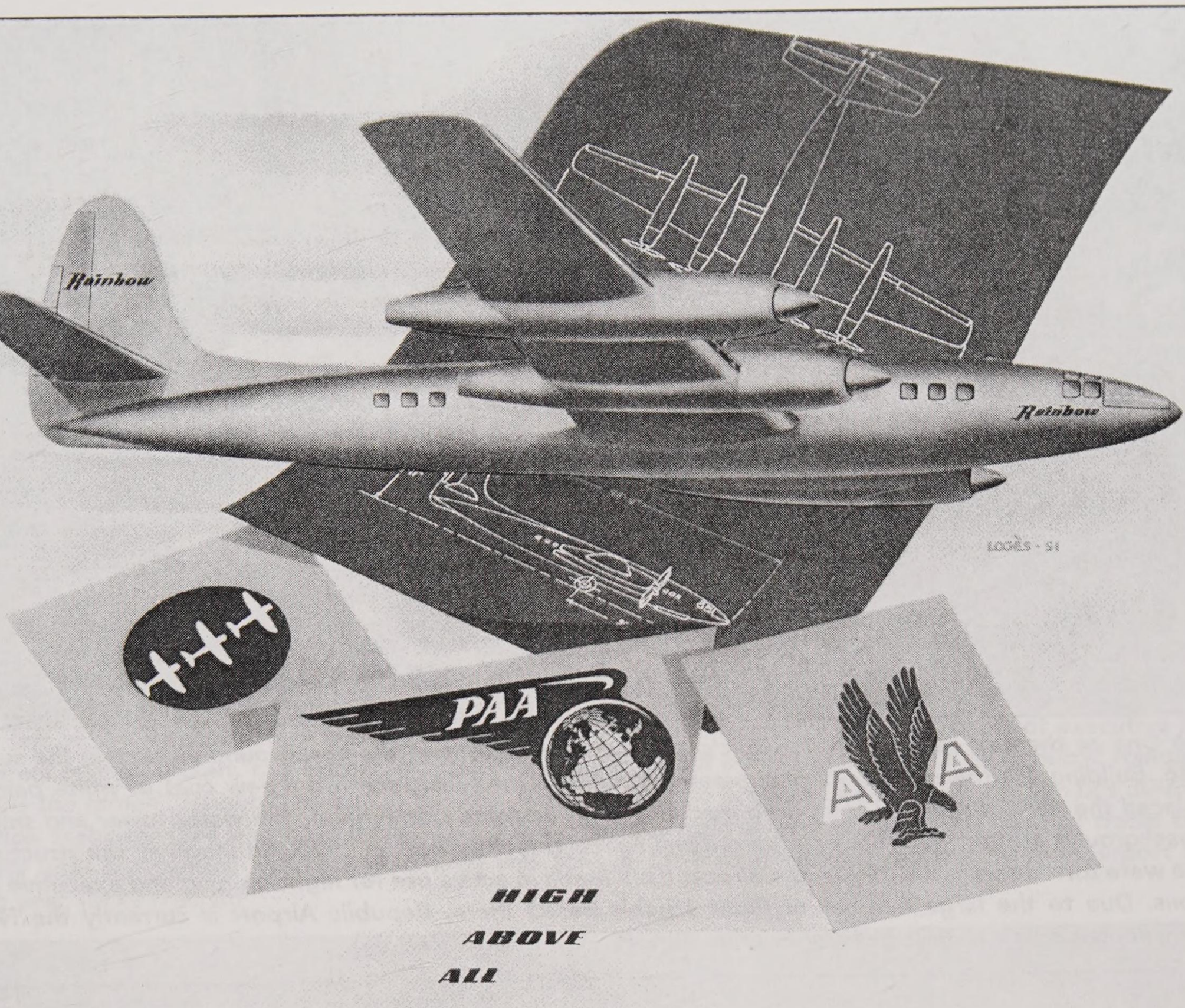
Serving in the role of aerial tanker, this KC-12 would have offered the Strategic Air Command 400-mph refueling speeds, thus negating problems encountered by Boeing KC-97 and KB-50 tankers when refueling the Air Force's new breed of jet-powered nuclear-armed bombers. Unlike those aircraft that had to "toboggan" downhill to maintain flying speed while refueling B-47 Stratojets (or Century Series fighters for the Tactical Air Command), the KC-12 could have easily maintained level flight while refueling all the new jets. (Digital Illustration by Tony Landis)



The Air Force EC-12R Electric Rainbow spyship looks even more sinister wearing Vietnam-era Jungle Camouflage. Equipped with wingtip-mounted fuel tanks, this aerial intelligence-gathering platform would have been able to cover a lot of ground with its 400-mph cruise speed. Intercepting and monitoring enemy communications has always been at the forefront of effective military intelligence, and the EC-12 would have offered performance similar to the Navy's Lockheed P-3 Orion turboprop, which first flew in 1959 and is still in operational use today. (Digital Illustration by Tony Landis)



Navy WV-12 early-warning radar picket combines the structural attributes of the Lockheed WV-2 Warning Star radar Constellation with the ELINT capabilities of the Lockheed P-3 or EC-130 Hercules used in that role. The Republic airplane's cavernous interior would have provided ample room for banks of radar consoles and radio intercept stations as were fitted to the aforementioned aircraft, although its 400-mph cruise speed would have indeed been compromised by the induced drag of the upper and lower radomes. In 1946, Republic had actually proposed a "Ferret Radar" version of the XF-12, to be manned with 15 crewmembers. (Digital Illustration by Tony Landis)



HIGH
ABOVE
ALL
IN
GLOBAL
TRANSPORTATION

THREE GREAT NAMES . . . THREE GREAT COMPANIES . . . COLLABORATE ON THE INAUGURATION OF LONG DISTANCE AIR TRANSPORTATION WHICH ASSURES TOMORROW'S GLOBE TROTTER THE ULTIMATE IN TRAVEL . . . TO EVERY IMPORTANT SPOT ON EARTH. WHEN AMERICAN AIRLINES AND PAN AMERICAN WORLD AIRWAYS PUT INTO OPERATION, IN THE NOT TOO DISTANT FUTURE, THEIR GREAT FLEETS OF REPUBLIC RAINBOWS NOW ON ORDER . . . WITH A CRUISING SPEED OF OVER 400 M.P.H., A NEW ERA . . . AN ENTIRELY NEW CONCEPT . . . OF SPEED, COMFORT AND LUXURY WILL BE BORN . . . FAR IN ADVANCE OF TODAY'S BEST STANDARDS.

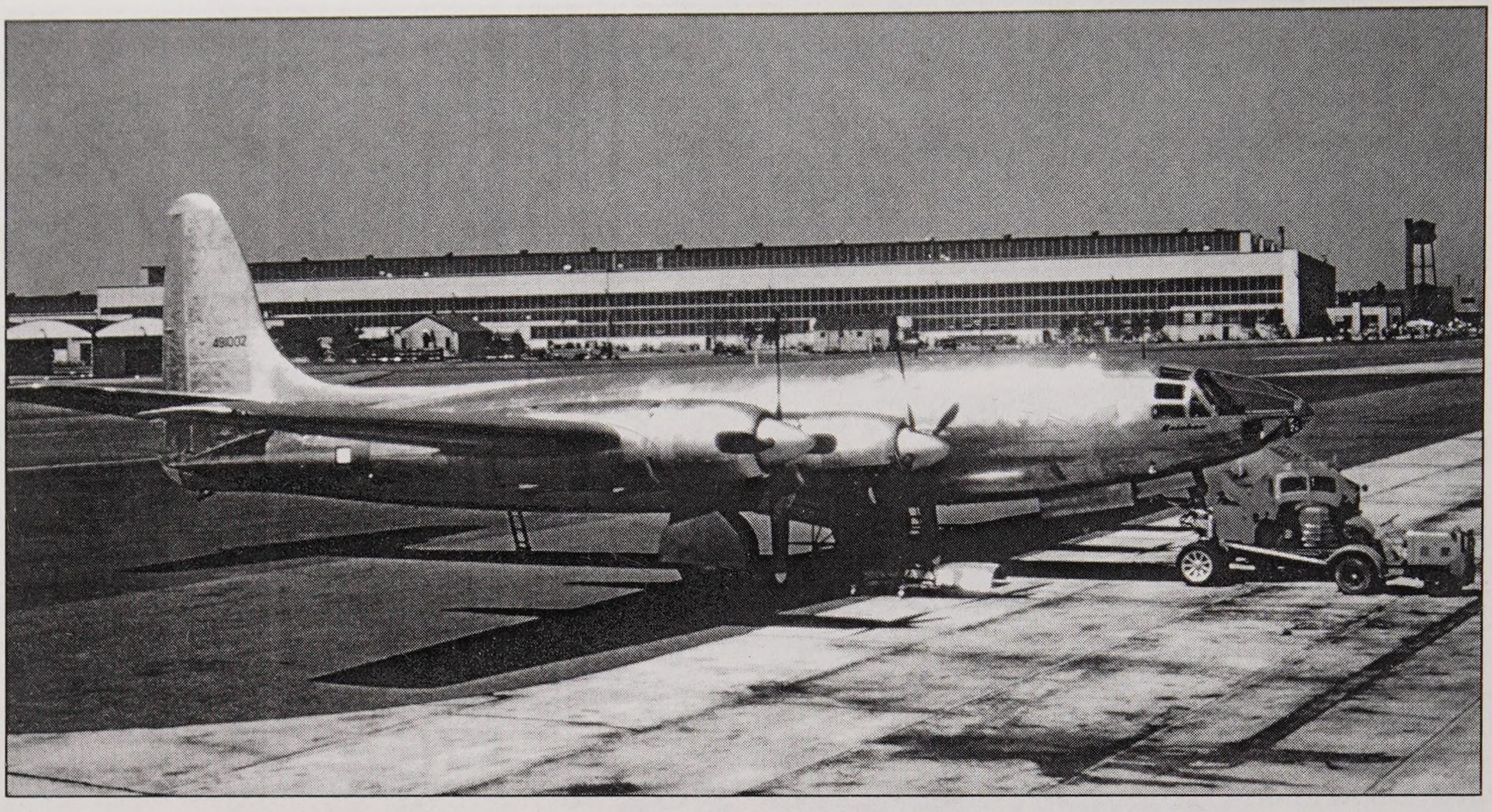
DESIGNED AND BUILT BY REPUBLIC AVIATION CORPORATION, FARMINGDALE, LONG ISLAND, NEW YORK

REPUBLIC Rainbow

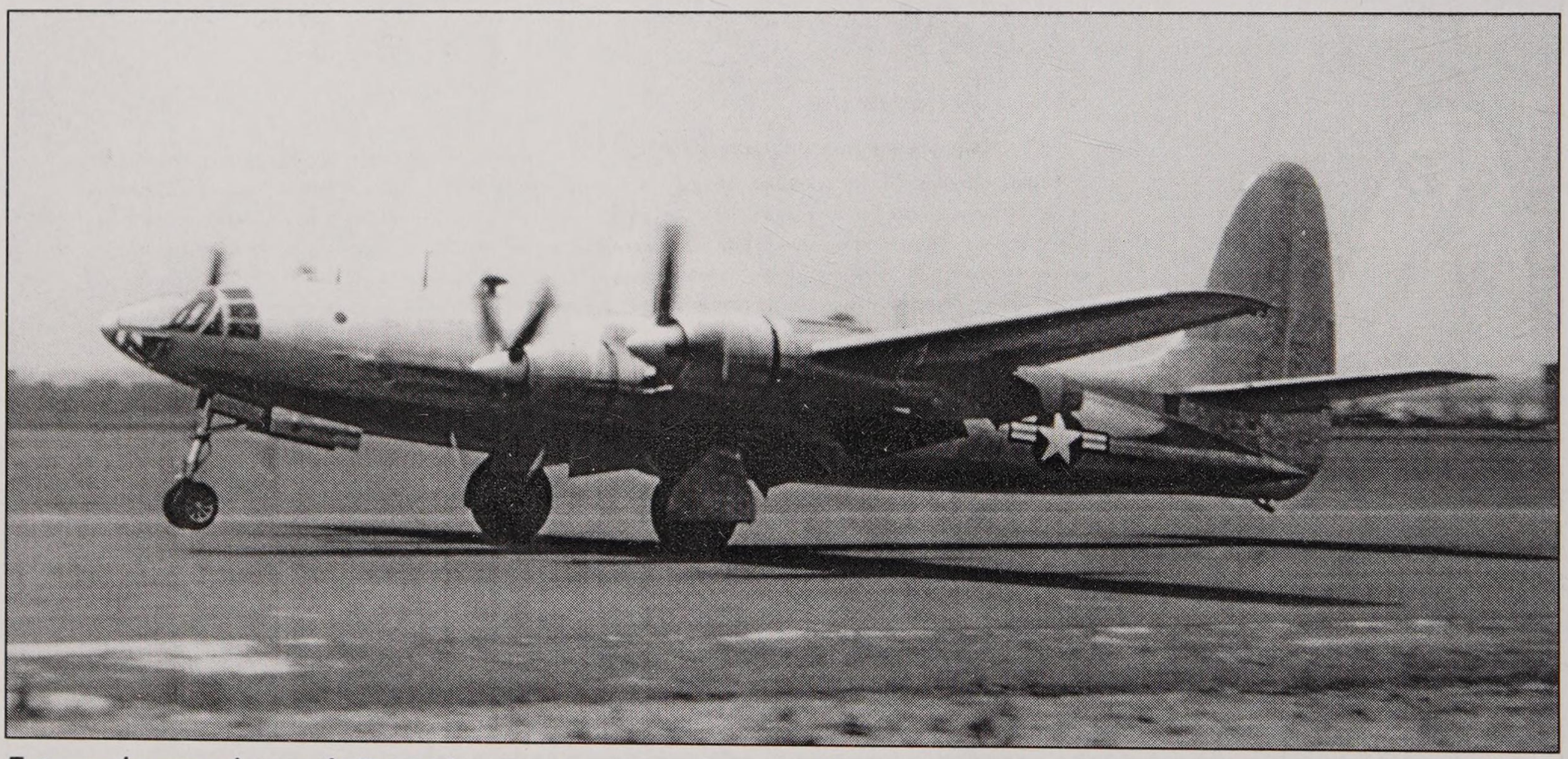
A PRODUCT OF REPUBLIC AVIATION

Makers of the Mighty Thunderbolt

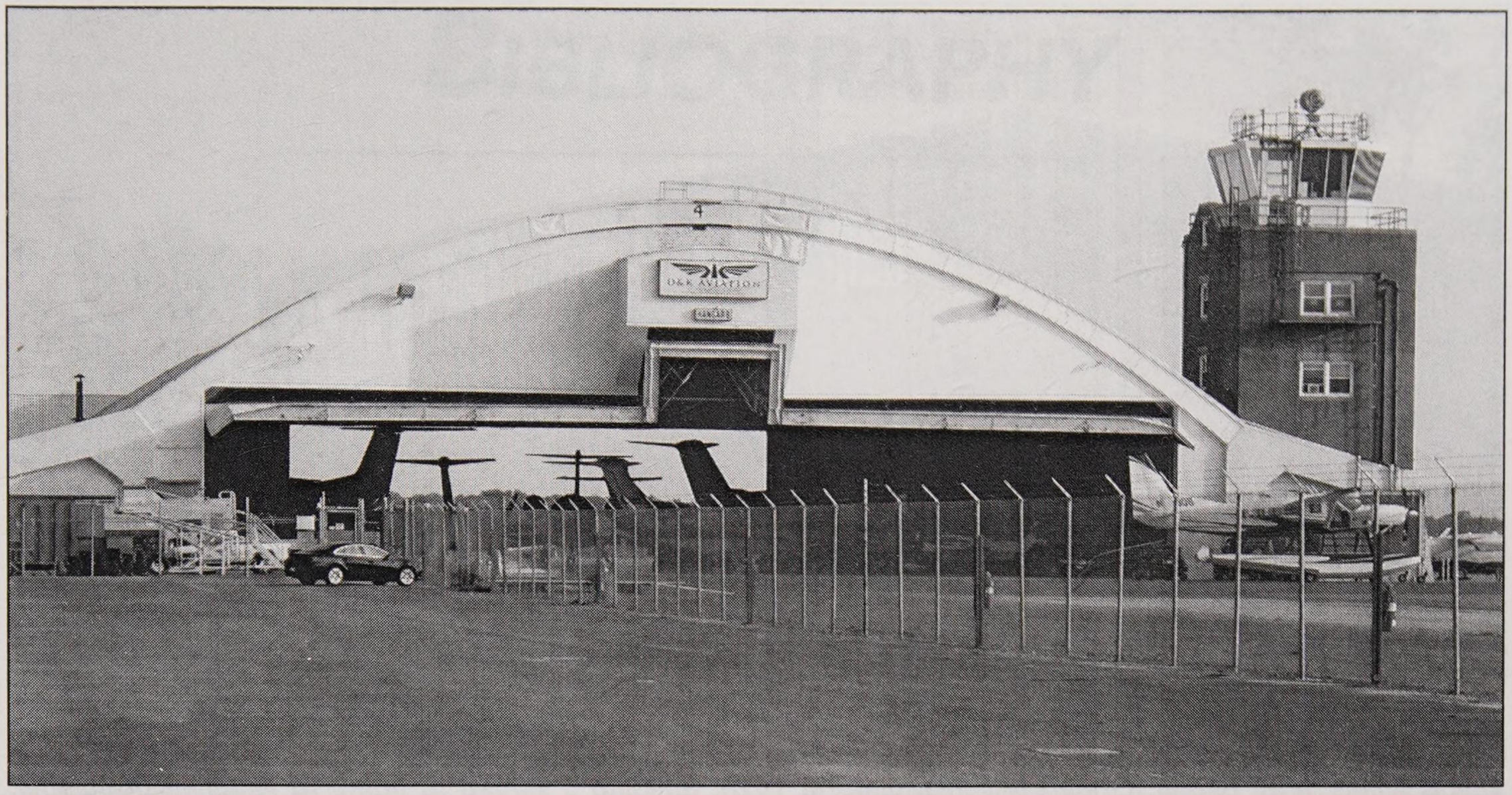
Artistic license comes into play in this handsome advertisement for the RC-2 Rainbow. Here, the artist has taken a photo of the XF-12 and then airbrushed a quasi-airliner configuration over the prototype military aircraft. The Douglas-inspired window line is obviously for visual effect only. This ad was published sometime between July 1946 and January 1947 when standing orders from American Airlines and Pan American World Airways were still on the books. (Courtesy of Ryan Crierie)



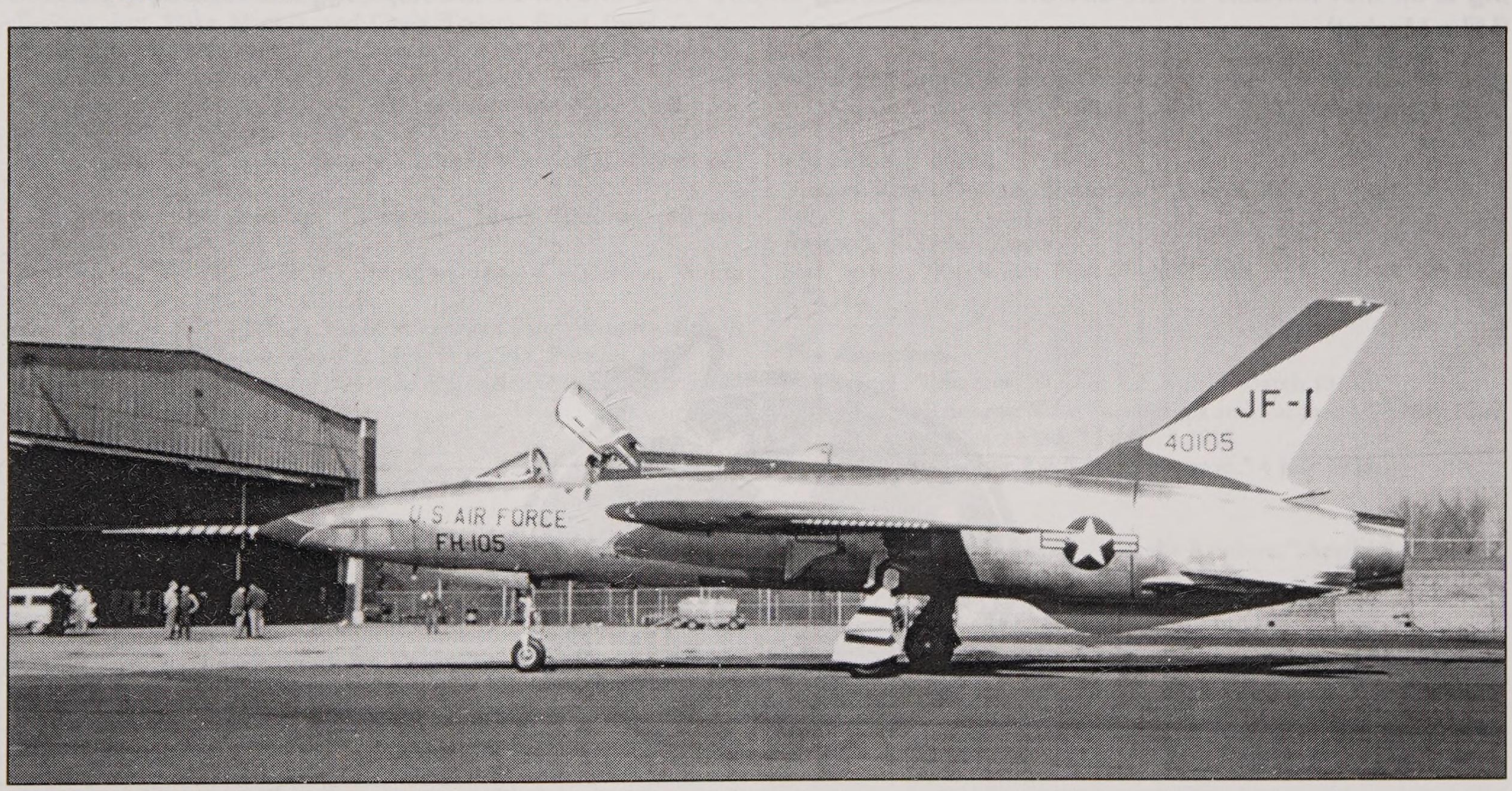
Ship One on the east ramp, with Republic's manufacturing facility in the background as seen in the summer of 1946. Building 17, the company's final assembly building, had just received a new coat of white paint, which replaced the dark brown and olive drab markings of its wartime camouflage. The water tower and smokestack in background at right date back to the original Fairchild factory built in 1926. Although all the structures seen here were torn down in the 1990s, the airport itself is still in active use for flight training and executive jet operations. Due to the large number of flight schools based there, Republic Airport is currently the New York metropolitan area's busiest general aviation airport. (Jay Miller Collection)



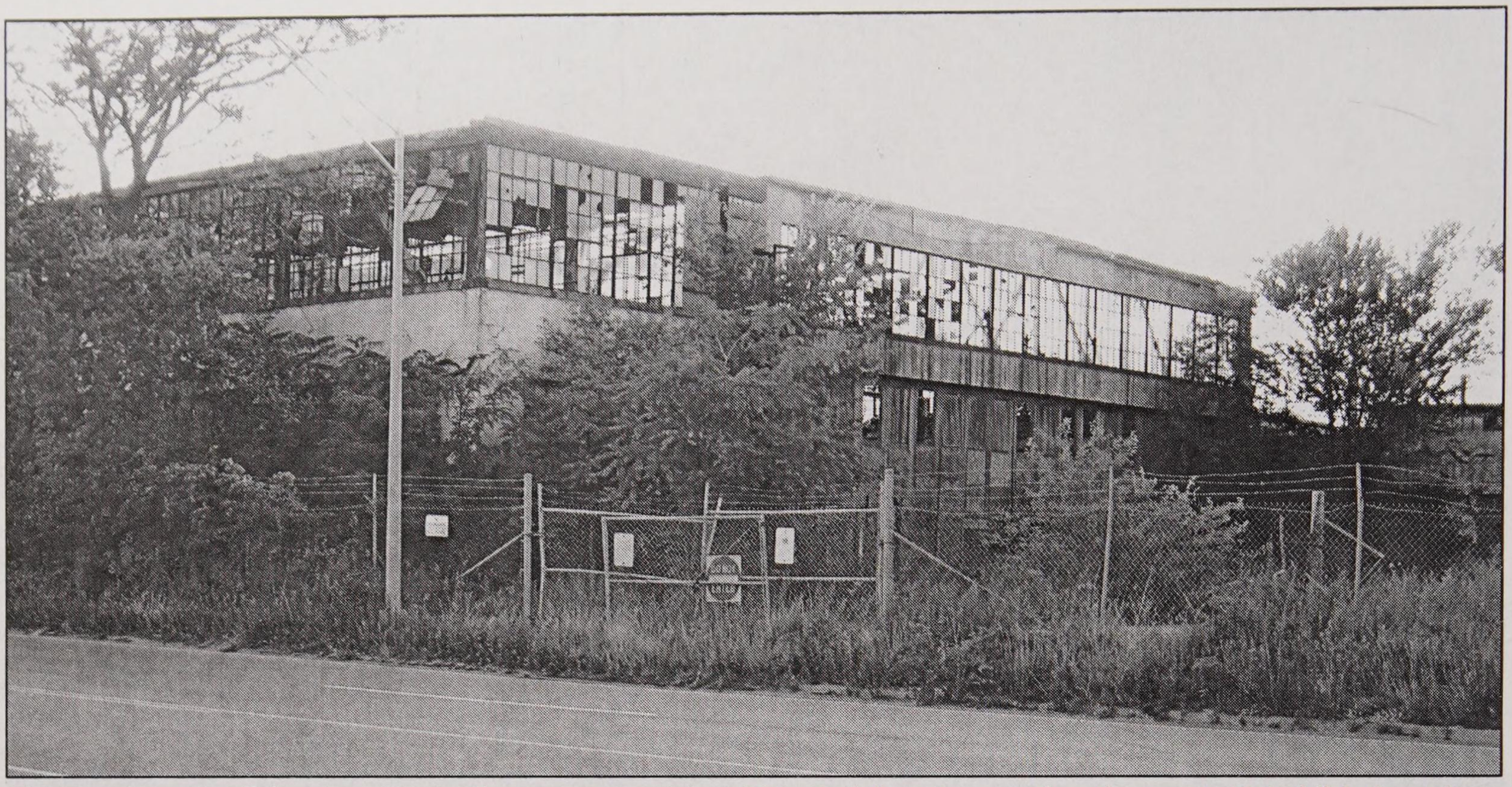
Extremely rare photo of XF-12 Ship Two touching down on Runway one-nine at Farmingdale. Wearing post-1947 national insignia with the center bar, the airplane had yet to receive its "U.S. AIR FORCE" lettering on the forward fuselage. Note extended tail bumper visible below the aircraft's stub ventral fin. The XF-12's pronounced nose-up-stance on its gear gave little room for a pilot over-rotating on takeoff or landing. Ship Two, the more advanced XF-12 prototype, had a relatively short service life compared to the first airplane. Its maiden flight took place on 12 August 1947 and the aircraft crashed only 14 months later at Eglin AFB, Florida, on 7 November 1948. (Jay Miller Collection)



All that's left of the Rainbow story is Hangar 4 at Republic Airport. Currently home to fleets of executive jets and privately owned aircraft, this historic hangar was originally built during World War II as Republic Hangar 3 and retains the famed "Rainbow notch" in its door that was built to provide clearance for the XF-12's 30-foot-high vertical stabilizer (See photo on page 58). Control tower at right served as Republic's main air traffic control facility until the private and restricted field was sold in 1965 to become a general aviation airport the following year. (Mike Machat)



Republic's last attempt at providing the Air Force with a high-speed photo-reconnaissance aircraft was tested on the JF-105B. Pictured here wearing flight test markings at Farmingdale in April 1959 is JF-1 (S/N 54-0105), the first of three special pre-production prototype F-105s fitted with provisions for cameras in a modified "photo nose." No actual cameras were ever used on these jets, however. Originally designed as a Cold War nuclear weapons carrier, the F-105 delivered 75 percent of all Air Force ordnance to targets in North Vietnam within 10 years of becoming operational. Of the 833 F-105s built, 335 were lost to combat action or accidents in that war from 1964 to 1972. (Author Collection)



This is where it all began. Originally constructed in 1926, Building 5 served as home to Fairchild, American, Grumman, Seversky, and then Republic, until larger facilities were constructed for that company's rapid buildup of aircraft production during World War II. Retaining "historic landmark" status today after vociferous action by the Fairchild family, the once-proud manufacturing building now sits abandoned and derelict on Conklin Avenue, directly across from the new Airport Plaza shopping center. Although Republic's three former hangars still exist on the eastern edge of the airfield and are now occupied by a flight school, an FBO, and a museum, this building is all that remains of the aircraft manufacturing empire once known as the Republic Aviation Corporation. (Mike Machat)

REPUBLIC AVIATION CORPORATION

BIBLIOGRAPHY

Books

Davies, R.E.G., *Airliners of the United States Since 1914*, Washington D.C., Smithsonian, 1972.

———, *Howard Hughes: The Man and His Aircraft*, McLean, Virginia, Paladwr Press, 2006.

Fairchild Hiller Corporation, *Yesterday, Today, and Tomorrow: Fifty Years of Fairchild Aviation*, Hagerstown, MD, Fairchild Hiller Lithographic Services, 1970.

Francillon, Rene. J., *Lockheed Aircraft Since 1913*, London, England, Putnam, 1982.

Jenkins, Dennis R., *Magnesium Overcast*, North Branch, Minnesota, Specialty Press, 2001

———, *Cold War Peacemaker*, North Branch, Minnesota, Specialty Press, 2010

Kartveli, Alexander, *Engineering Aspects of the Development of the Rainbow*, Farmingdale, New York, Republic Aviation Corporation, 1946.

Maloney, Edward T., *Sever the Sky, The Evolution of Seversky Aircraft*, Corona Del Mar, California, World War II Publications, 1979.

Marrett, George, *Howard Hughes, Aviator*, Washington D.C., Naval Institute Press, 2004.

———, *Testing Death*, Washington D.C., Naval Institute Press, 2005.

———, *Contrails Over the Mojave*, Washington D.C., Naval Institute Press, 2006.

Merlin, Peter W., and Tony Moore, *X-Plane Crashes: Exploring Experimental, Rocket Plane, and Spycraft Incidents, Accidents, and Crash Sites*, North Branch, Minnesota, Specialty Press, 2009.

National Air and Space Museum, *The Earth From Above*, Photo reconnaissance exhibit, Washington, DC, 2010

Proctor, Jon, Mike Machat, and Craig Kodera, *From Props To Jets: Commercial Aviation's Transition to the Jet Age*, North Branch, Minnesota, Specialty Press, 2010.

Seversky, Alexander P., *Victory Through Airpower*, New York City, New York, Simon and Schuster, 1942

Stoff, Joshua, *The Thunder Factory*, Osceola, Wisconsin, Motorbooks International, 1990.

———*Long Island Airports,* Charleston, South Carolina, Arcadia Books, 2004.

———*Long Island Aircraft Manufacturers*, Charleston, South Carolina, Arcadia Books, 2010.

Swanborough, F.G., (Bowers, Peter, M.) *United States Military Aircraft Since 1909*, London, England & New York, NY, Putnam, 1963.

U.S. Air Force, *Army Airforce Report of Major Accident*, Eglin Air Force Base, Florida, December 1948.

Periodicals

AAHS Journal

Hendrix, Lin, "(Flying) the Republic XR-12 Rainbow," Winter 1976.

See, Earl, "Remember When," Spring 2010.

Airpower Magazine

Machat, Mike, "From Boom to Bust: Postwar General Aviation Aircraft," January 2003.

White, Graham, "Engine of the Future," May 2006.

Zichek, Jared A., "Promoting the XP-58 Chain Lightning," May 2005.

Air Pictorial

Cowin, Hugh, W., "Republic Rainbow: Flights of Fancy-4," December 1981.

Aviation Quarterly

Hallion, Dr. Richard P., "The Republic XF-12/RC-2 Rainbow: Twilight of the Piston-Powered Airplane," First Quarter 1977, Volume Three, Number One, January 1977.

Aviation History

Johnson, E.R., "Twin-Boom Boondoggle," May 2010.

Aviation

Staff writer, "Republic Rainbow: New Global-Transport Bid," October 1945.

Aviation Week

McLarren, Robert, "F-12 Based on Fighter Experience," 10 November 1947.

Fairchild Republic News

Staff writers, 50th Anniversary Special Issue, Published in 1981.

Flight

Staff writer, "Republic Rainbow, A Transport of Exceptional Performance: Impressions of a Military Prototype," 22 August 1945.

Fortune

Staff writer, "Experiment at Republic," February 1947.

IPMS Quarterly

Donath, Charles, "XF-12 Rainbow: Pot of Gold or Colorful Illusion?" Vol. 14, No. 1.

LIFE

No author listed, "Speaking of Pictures: 192-Foot Air Photo Shows U.S. Coast-to-Coast," Volume 25, No. 22, 29 November 1948.

Los Angeles Times

Vincent, Roger, Business Section, 15 October 2010.

Republic Aviation News

Staff writer, "Rainbow's First Flight Thrills RACers," 15 February 1946.

The Aeroplane

Staff writer, "Rainbows Still for P.A.A.," 14 March 1947.
Staff writer, "Rainbow: With Turboprops and Turbojets," 5 May 1950.
Staff writer, "Arc in the Sky," 11 April 1958.
Staff writer, "Republic Rainbow Turboprop," 4 July 1958.

Wings

Machat, Mike, "Somewhere Under the Rainbow," April 1994.

———, "Jaunty Alouette," June 2006.

Marrett, George, "The Mystery Ship," February 2005.

———, "Flights Into the Future," December 2005.

Merlin, Peter W., and Tony Moore, "The Crash of the XF-11," February 2005.

INDEX

A

Aberdeen Proving Grounds, MD, 118
Aeroproducts, 17, 19
Air Car (See Spencer)
Allison Engines,
  T40, 102
  501, 103, 124
American Airlines, 22, 29, 31, 38, 82, 93, 95, 97, 98, 101, 132, 135, 137
American Airplane & Engine Company, Amityville, NY, 21
Army Air Forces Materiel Command, 16, 39
Army Air Technical Service Command, 14, 16
Ascani, Gen. Fred, 108, 109

B

Barnes, Pancho, 13
Bagley, James, 13
Beverly Hills, CA, 84, 86
Boeing Airplane Company, 13, 14, 17, 30, 41, 42, 47, 81, 92, 93, 96, 97, 99, 100, 102, 103, 109, 112, 113, 117-122, 124, 134, 135
  B-17 Flying Fortress, 14
  B-29 Superfortress, 14, 17, 97, 109, 119, 121
  F-13 Superfortress, 14
  B-50 Superfortress, 41, 112
  RB-50 Superfortress, 113, 118
  B-47 Stratojet, 121, 122
  RB-47 Stratojet, 120
  ERB-47 Stratojet, 102, 120-122
  C-97 Stratofreighter, 99
  KC-97 Tanker, 121, 122, 135
  KC-135 Stratotanker, 121
  377 Stratocruiser, 41, 99
  707, 100, 103
  2707 SST, 100
  Sonic Cruiser, 102
  787 Dreamliner, 102
Blandford, Gene, 84
Brabham, Lowery L., 27, 58–60, 62, 65, 105
Broughton, Col. Jack, 4, 5, 7, 9, 18
Byrd, Admiral Richard E., 21

C

Cagney, Bill, 83
Choctawhatchee Bay, FL, 114, 115
Clark, Maj. Delbert, 109
Clipper (see Pan American)
Collins, L. R. "Pete," 105, 106
Concorde SST, 96
Consolidated B-24 Liberator, 14
Convair, 29, 47, 58, 98, 100, 103, 117, 119, 125, 126
  RB-36 Peacekeeper, 119
  240, 73, 98
  990 Coronado, 100, 102
Corona Project, 129
Creamer, James, 58, 59, 105, 106
Culver City, CA, 16, 69-71, 73-75, 80-84, 86, 87, 89
Curtiss Electric, 19, 49, 50, 73, 86
Curtiss Field, 20
Curtiss-Wright, 31, 49, 97

D

Damon, Ralph, 31
De Havilland, 10, 14, 102
  Mosquito, 14
  Comet 1, 102
De Seversky (see Seversky)
Dehmel Electronics, 97
Directorate of Requirements, 117
Directorate of Research & Development, 117
Doolittle, Gen. Jimmy H., 16, 112
Douglas Aircraft Company,
  A-20, 73, 82, 83, 84, 87
  DC-3, 98, 101
  C-47 Skytrain, 87
  C-54 Skymaster, 64, 101
  R5D Skymaster, 101
  XB-42 Mixmaster, 31
  Cloudster II, 31
  DC-4, 29, 42, 98, 101
  DC-6, 93, 96, 98, 100, 115
  DC-6 *Independence*, 93, 96, 97, 98, 115
  DC-6B, 93, 135
  DC-8, 100
Thor Missile, 129
Dural 75ST Aluminum, 42, 72
Duramold Process, 69

E

Edwards AFB, CA, 5, 8, 85, 107, 108, 112, 125
Eglin AFB, FL, 86, 88, 109, 113-115, 138
  3200th Proof Test Group, 113
  Photo Test Squadron, 113
Eielson AFB, AK, 121
Elliot, Capt. William W. "Bill," 9, 18, 65, 67, 109
El Segundo, CA, 81
Evansville, IN, 28, 31, 57, 104, 105

F

Fairchild Aircraft Company,
Farmingdale plant, 21, 22, 29, 140
  FC-2, 21
  FC-2W2, 21
  Model 71, 21
  Stars & Stripes, 21
  C-119 Flying Boxcar, 47
Fairchild Camera,
  K-17, 15, 52, 54, 78, 109, 111
  K-18, 51, 52, 110
  K-19, 40, 52
  K-22, 51, 52, 54, 78, 110, 111
Fairchild, Sherman Mills, 21
Farmingdale, NY, 4-9, 20-23, 25, 30, 31, 33, 35-37, 57, 58, 64, 65, 83, 93-95, 100, 103, 105, 109, 116, 118, 123, 124, 126, 138, 139
Flagship (see American Airlines)
Franklin engine, 32, 33

G

General Electric, 17, 47, 48, 73, 93, 100, 103, 117, 119, 120
  Superchargers, 48
  J47 Turbojet engine, 119, 120
Goddard, Gen. George, 13, 112
Great South Bay, NY, 32, 60, 109
Groom Lake, NV, 129
Grumman, Leroy, 22
Grumman Aircraft Company
  XFF-1, 22
  FF-1, 22
  JSF-1 Duck, 22
  F2F-1, 22
  F3F-1, 22
  Gulfhawk, 22
  Bethpage plant, 22
  Farmingdale plant, 4-9, 20-23, 25, 30, 31, 33, 35-37, 57, 58, 64, 65, 83, 93-95, 100, 103, 105, 109, 116, 118, 123, 124, 126, 138, 139
  Calverton plant, 58

H

Hagerstown, MD, 21, 25
Hamilton-Standard, 19, 73, 82, 83, 86, 87
Haas, Oscar P. "Bud," 58, 59, 105-107, 125
Hildebrand, George, 8, 9, 36, 41-43, 56, 125, 126
Hosford, MSgt. Gerald J., Jr., 113
Hughes, R. Howard R., 16, 31, 68, 69, 71, 72, 79-82, 83, 85, 86, 123
Hughes Aircraft Company, 16, 68, 71, 76, 81, 124
  H-1 Racer, 80, 124
  DX-2, 16, 68-72, 90
  D-5, 16, 17, 68, 70-72
  XF-11, 9-11, 19, 47, 48, 51, 68, 71-76, 78, 79, 82-91, 108, 109, 119, 123, 124, 127, 134
  HK-1 Hercules, 80, 81, 124, 129, 136
  XH-17 Sky Crane, 124
  AIM-4 missile, 81
Hughes Helicopters, 81
Hughes Space & Communications, 81, 124

I

Intervalometer, 52, 110

K

Kartveli, Alexander, 6, 7, 20, 25, 27, 64, 95, 100, 103
Keillor, Maj. Russell, 20
Kellett, Walter, 26, 31

L

Lee, MSgt. Howard C., 113, 115
Lewis, John, K., 9, 121, 133
LIFE magazine, 112
Lockheed Aircraft Company
  P-38 Lightning, 10, 14, 16, 27, 71, 72
  F-5 Photo Lightning, 14–16
  XP-58 Chain Lightning, 71
  C-69 Constellation, 68
  749 Constellation, 99
  Little Dipper, 31
  Big Dipper, 31
  Model 60, 31
  L-188 Electra, 80, 103
  U-2 Dragon Lady, 54, 121, 128, 129
  C-130 Hercules, 129
  SR-71 Blackbird, 128, 129
Lockheed Advanced Design Company, 129
Lowe, Thadeaus, 13
Lucky Lady II, 119
Luke Air Force Base, AZ, 5

M

Marchev, Alfred, 31-33, 36, 37, 95, 104
Marrett, George, 9, 108
Martin Aircraft Co.,
  B-10, 13
  404, 10, 98, 99
McCook Field, OH, 13
Merlin 61, 14
Meeker, Capt. Everett R., 88
Miller, C. Hart, 9, 20, 138
Mitchel Field, NY, 9, 112
Mitchel, Mayor John P., 112
Mitchell, Gen. Billy, 23, 112
Morgan, Capt. C.W., 113, 115
Muroc, CA, 85, 86, 107, 109, 112
Murphy, Audie, 83

N

NAS Pensacola, FL, 115
North American Aviation Corporation
  P-51 Mustang, 27, 31
  F-6 Photo Mustang, 14
  B-45 Tornado, 71, 120
  RB-45, 120
  Navion, 31
Northrop, Jack, 130
Northrop Aircraft Incorporated,
  P-61 Black Widow, 72, 73, 87
  XB-35 Flying Wing, 47
  F-15 Reporter, 8, 90
Northrop Grumman, 126, 129, 130
  RQ-4 Global Hawk, 129, 130

O

Odekirk, Glenn, 71, 83, 84
Operation "Birds-Eye," 112

P

Palmer, Sgt. Vernon B., 113, 115
Pan American Airways, 21
Pan American World Airways, 81, 95, 98, 101, 135, 137
Peale, Mundy I., 4, 6, 7, 104, 105
Peters, Jean, 83
Photo Development Lab, 112
Photo Interpreting, 18
Potez 840, 103
Powers, Francis Gary, 4, 57, 129
Pratt & Whitney, 13, 17, 21, 23, 24, 26, 27, 39, 41, 47, 48, 56, 59, 69-71, 73, 87, 90, 95, 98-100, 109, 117, 119, 121
  R-2000, 47
  R-2800, 4, 27, 48, 69, 70, 72, 98
  R-4360-31, 13, 47, 48, 73
  R-4360-51, 117
Prinz, Frank, 83
Proctor, Jon, 9, 101
Project Corona, 129

R

RAF Brize Norton, 121
Ranger Aircraft, 23
Raytheon, 81, 124
Ravens, 120, 121
Republic Airport, 35, 60, 138, 139
Republic Aviation Corporation, 4, 9, 11, 17, 20-22, 25-27, 29, 31, 39, 59, 123, 124, 140
  R-4 airfoil, 43
  P-43 Lancer, 8, 26, 27
  XP-47 Thunderbolt, 27
  XP-47A, 27
  XP-47B, 20, 27, 58, 59, 105
  P-47B, 27
  P-47C, 27
  P-47D, 28, 48, 63
  XP-47J, 39
  P-47N, 28, 38
  XP-69, 8
  XP-72, 8, 39
  XF-12, 9, 13, 14, 16-19, 30, 31, 36-68, 72-74, 78, 82, 93, 95, 97, 99-101, 104-112, 115, 117, 118, 125, 131-134, 136-139
  XR-12, 12, 7, 10, 11, 19, 78, 89, 92, 93, 98, 100, 107, 109, 112-119, 122, 126, 127, 130, 131
  F-12A, 18, 116-118, 134
  RC-1 Prototype, 32, 33, 38
  RC-2 Rainbow, 9, 36, 37, 42, 43, 63, 92–100, 102, 103, 105, 116, 132, 135, 137
  RC-3 Seabee, 30, 33-35, 37, 38, 47, 49, 105, 116, 123, 124
  F-84 Thunderjet, 5, 8, 30, 37, 45, 46, 51, 105, 116, 124, 125
  F-84F Thunderstreak, 5, 6, 8, 124-126
  RF-84F Thunderflash, 9, 124, 126
  XF-84H "Thunderscreech," 126
  XF-91 Thunderceptor, 8, 9, 125
  XF-103 Thunder Warrior, 6, 7
  F-105 Thunderchief, 7, 8, 123, 124, 127
  JF-105B, 139
  Alouette II helicopter, 123, 124
  A-10 Thunderbolt II, 127
Rex Ocean Liner, 13
Riberdy, MSgt. Victor C., 113, 115
Rolls-Royce Dart, 103
Roosevelt, Col. Elliott, 16, 69, 107
Roosevelt Field, NY, 25, 112
Ryan BQM-34 Firebee, 18, 19

S

Senole, SSgt. William N., 113
Seversky, Maj. Alexander, 22, 23, 26, 130
Seversky Aircraft Corporation
  Farmingdale plant, 23, 25, 26, 140
  SEV-3, 25
  BT-8, 23–25
  AP-7, 24, 25
  AP-9, 26
  P-35, 25–27, 55
  EP-1, 25
  XP-41, 26, 27
  XP-43, 26, 27
Shaw, MSgt. Willard, 109
Sheppard AFB, TX, 89
"Skunk Works," 121, 129
Sowers, MSgt. Jack, 109
Spencer Air Car, 31, 32
Spencer, Percival, 31, 32, 35
Sperry, Elmer A., 21
Sperry, Lawrence B., 21
Split Vertical Cameras, 51
Spruce Goose (see Hughes HK-1)

T

Thieblot, Armand J., 25
Thule Air Base, Greenland, 121
Thunderbirds, USAF, 5, 6, 125
Thunderbolt Amphibian, 8, 26-28, 31-33, 38, 39, 58, 92, 123, 126, 127
Trans Continental & Western, 98
Trans World Airlines, 31, 81
Trimetrogon Cameras, 13, 40, 51, 53, 78, 109–112
Trippe, Juan T., 21, 95
Twin Wasp (See Pratt & Whitney R-2800)

V

Vertical Camera, 13, 15, 52, 107, 110, 111, 113
Vickers Viscount 800, 103
Victory Through Airpower, 26
V-E Day, 33
V-J Day, 28, 33
VDT (Variable Discharge Turbine), 47, 117, 118

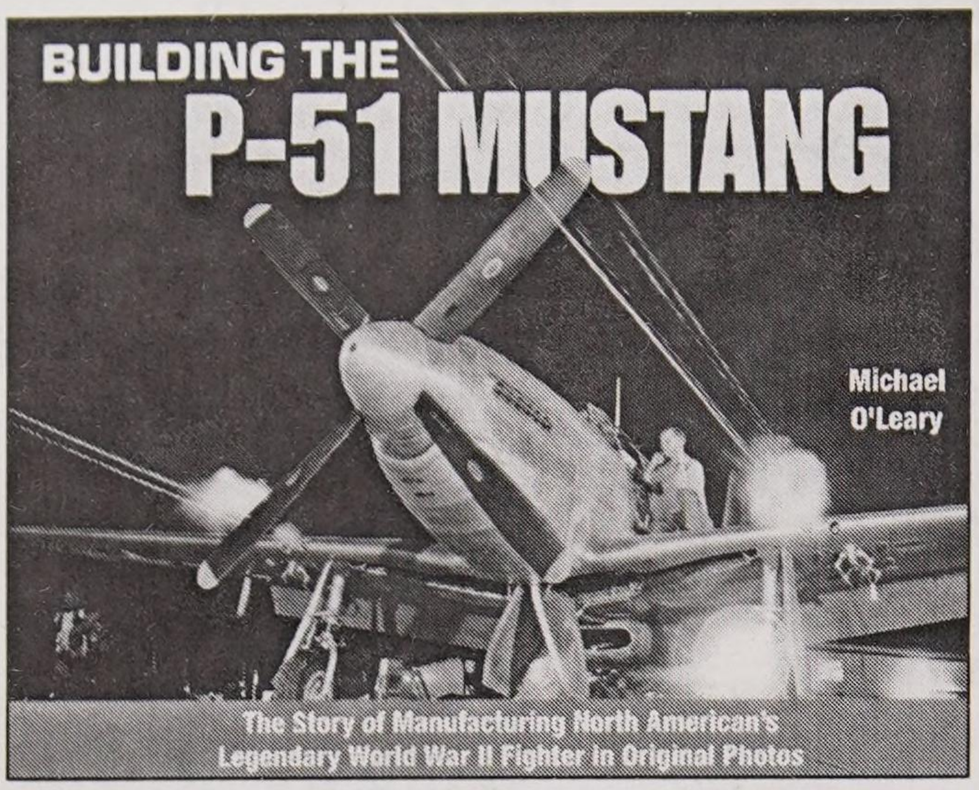
W

Wasp Major (See Pratt & Whitney R-4360)
Williams, Al, 9, 22, 117
Wing, TSgt. Richard, 109
Wright Field, 10, 13, 14, 16, 17, 19, 27, 39, 44, 50, 56, 65, 70, 71, 86, 88, 90, 105, 107–109, 113, 116

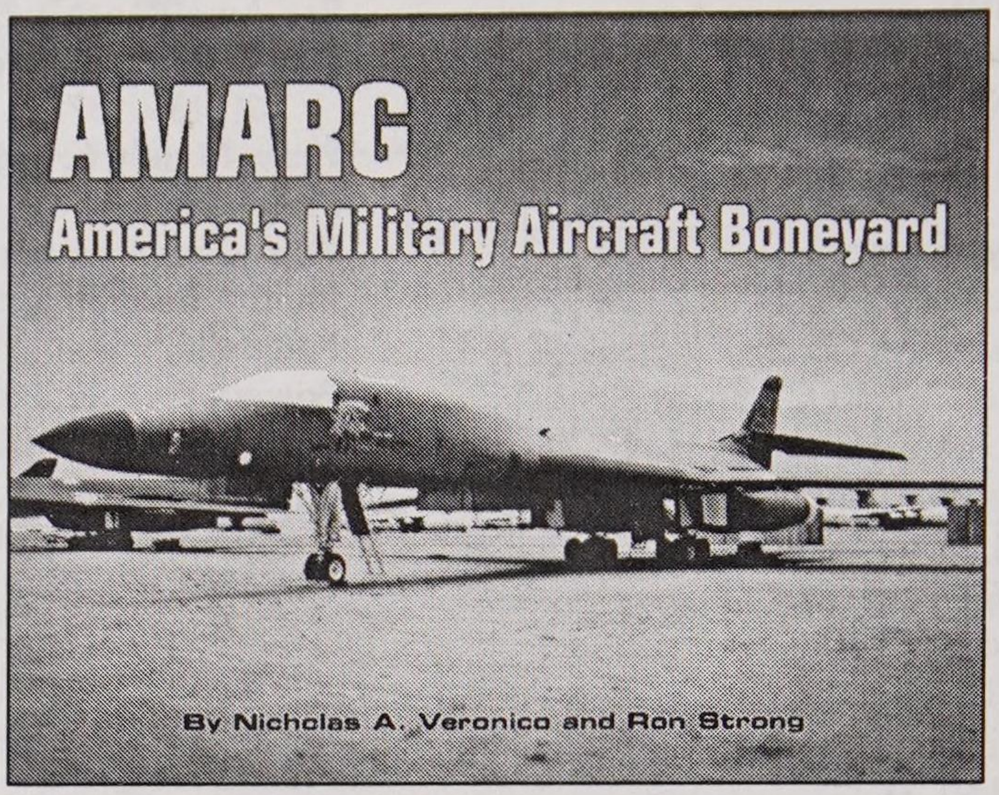
X

X-Hunters, 9, 86

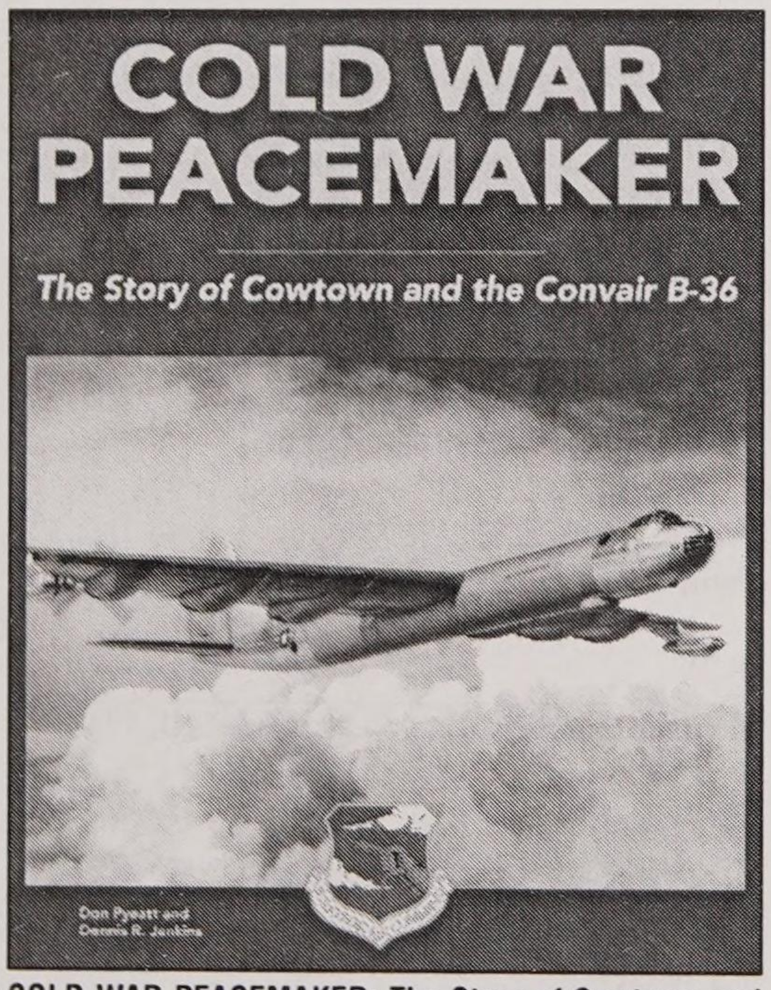
More Great Titles From Specialty Press



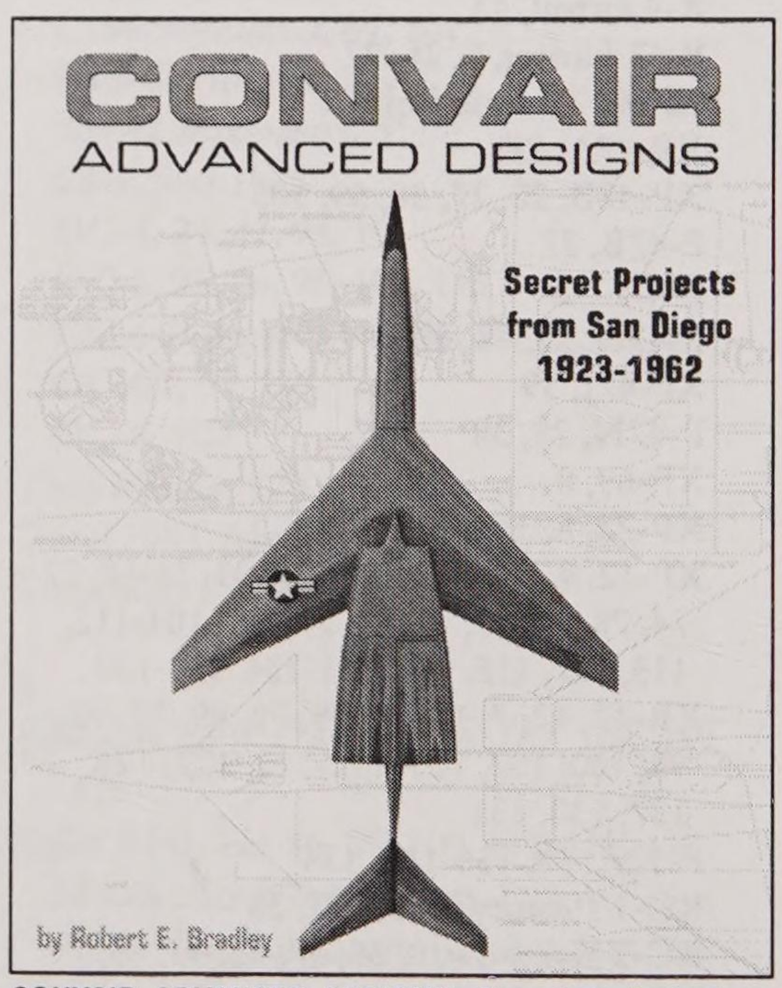
BUILDING THE P-51 MUSTANG: The Story of Manufacturing North American's Legendary World War II Fighter in Original Photos *Michael O'Leary* Now, for the first time, a major work devoted strictly to telling the story of how this legendary airplane was designed and built using rare original factory photographs, documents, and engineering information. The author uses mover 300 original photos culled from his archive of official North American and USAAF images, many have never before been seen in any publication. This book will provide a "missing link" in the saga of this famed World War II aircraft. Hardbound, 11x 8-1/2 inches, 240 pages, 300 b/w photos & 50 b/w illustrations. ***Part #SP152***



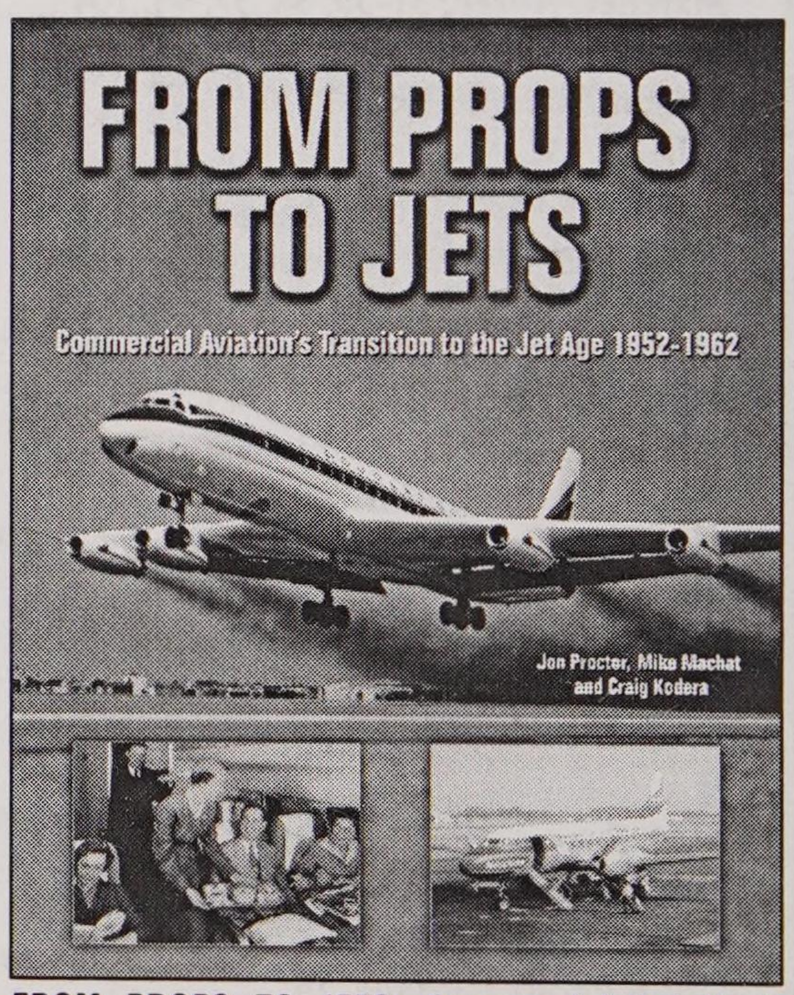
AMARG: America's Military Aircraft Boneyard *Nicholas A. Veronico and Ron Strong* This country's largest military aircraft storage center began as a desert site holding bombers and transports in reserve for possible future use. It later became a salvage and parts recovery operation, and a final resting place known as "the boneyard." In the 1950s and 1960s, with new wars erupting in Korea and Vietnam, certain aircraft stored in this desert center were once again in demand, and this famed storage and salvage facility answered the call. Photographs taken both from the air and on the ground show the reader vistas of the 4,000 airplanes stored at this site, while a detailed appendix gives a listing of all the aircraft types currently at AMARG (Aerospace Maintenance and Regeneration Group). Softbound, 11 x 8-1/2 inches, 144 pages, 50 b/w & 350 color photos. ***Part #SP139***



COLD WAR PEACEMAKER: The Story of Cowtown and Convair's B-36 *Dennis Jenkins & Don Pyeatt* The world's first intercontinental bomber served as a strategic deterrent against possible nuclear war and projected the global reach of the Air Force's new Strategic Air Command during the opening years of the Cold War. This book tells the B-36 story - the place where the airplane was designed, manufactured, and test flown. This book tells the story of this airplane's technical aspects, and the political and social events that led to its development and the establishment of Fort Worth as its production site. Hardbound, 8-1/2 x 11, 228 pages, 300 b/w photos with 20 illustrations. ***Item # SP127***



CONVAIR ADVANCED DESIGNS: Secret Projects from San Diego, 1923-1962 *Robert E. Bradley* Consolidated Vultee, which later became Convair, built some of the world's best flying boats in the 1930s, and the world's best bombers during World War II. But before all these great aircraft took to the skies, scores of ideas were proposed and analyzed by company management. This book brings these concepts to life for the very first time, featuring many never-before-seen company photos, models, and drawings of concepts such as a giant seaplane passenger transport launched from a high-speed rail car! Readers will also be fascinated to see how seemingly unbelievable designs evolved into production airplanes years later, such as the giant Convair Tradewind turboprop seaplane transport. Hardbound, 8-1/2 x 11 inches, 192 pages, 325 b/w photos & illustrations. ***Part #SP133***



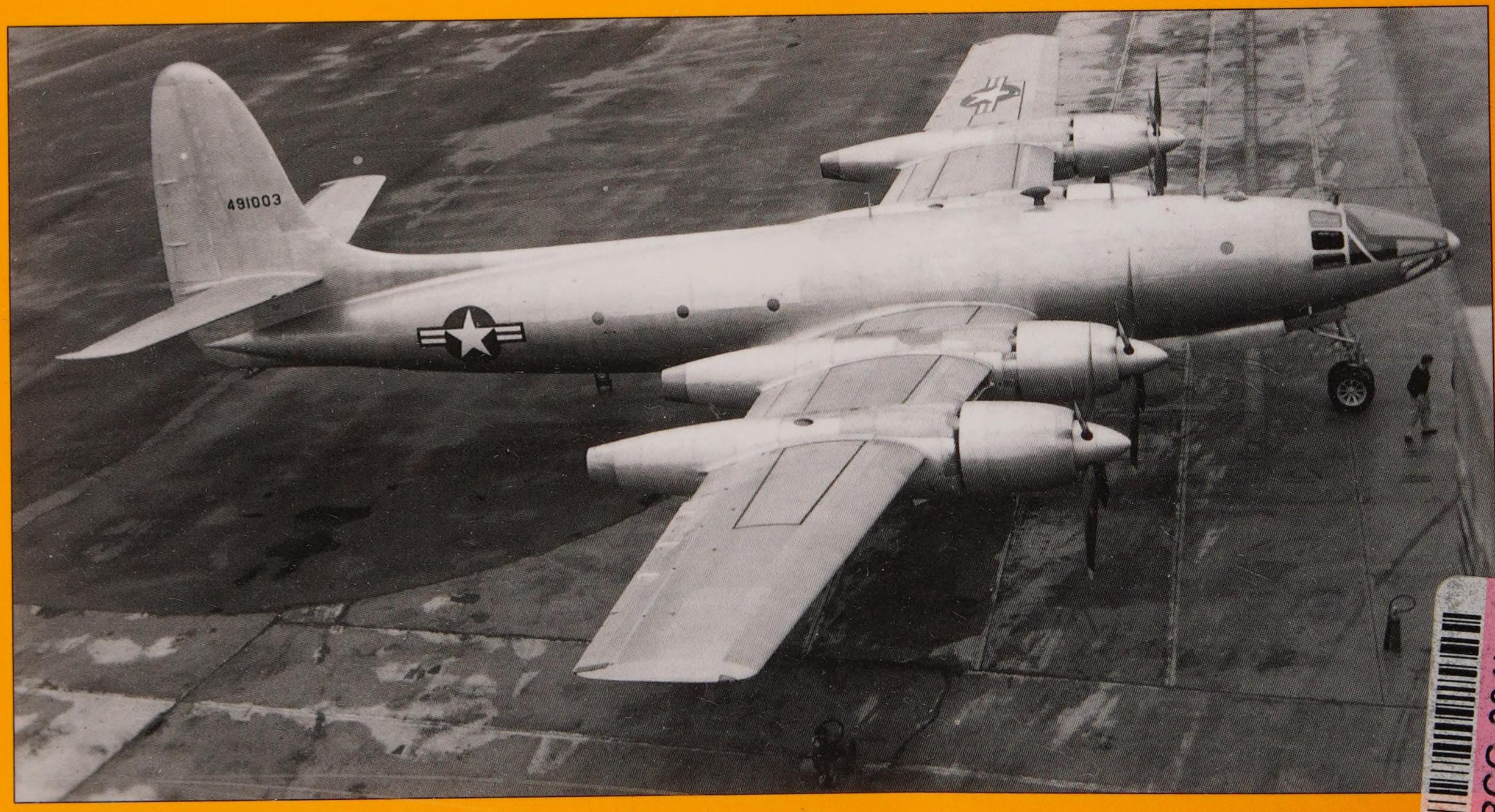
FROM PROPS TO JETS: Commercial Aviation's Transition to the Jet Age 1952–1962 *Jon Proctor, Mike Machat, & Craig Kodera* Although the years from 1952 to 1962 saw the rise and dominance of luxurious piston-powered airliners like the Douglas DC-7, Lockheed Constellation, and Boeing Stratocruiser, revolutionary new jet airliners soon rendered them obsolete. This book takes an in-depth look at all the aircraft that made commercial jet flight possible, comparing these radical new jetliners with the classic propeller-driven aircraft that preceded them. Hardbound, 8-1/2 x 11 inches, 160 pages, 120 bw & 60 color photos, 20 illustrations. ***Part #SP146***

Specialty Press
39966 Grand Avenue, North Branch, MN 55056
Telephone: (651) 277-1400 or (800) 895-4585 Fax: (651) 277-1203
www.specialtypress.com

CPSIA information can be obtained
at www.ICGtesting.com
Printed in the USA
LVOW09s1707210617
538891LV00016B/159/P

Republic's XR-12 was an airplane well ahead of its time in 1946. Envisioned as a long-range photo-reconnaissance aircraft with a top speed of more than 450 mph, the XR-12 also offered potential near–jet age performance for the world's airlines with a 40-passenger commercial version named the RC-2 Rainbow. Using rare original Republic photos and illustrations that have never before been published, author Mike Machat reveals, in vivid detail, many new aspects of the XR-12 and its RC-2 airliner variant. While the emphasis of this book is clearly on the Republic airplane, the Hughes XF-11 is also covered as a formidable twin-engine competitor to the more advanced Rainbow.

The XR-12 and XF-11 were among the most-elegant-looking and highest-performance piston aircraft ever built. While the Rainbow was considered Republic chief designer Alexander Kartveli's ultimate masterpiece, the XF-11 nearly caused the demise of its creator and test pilot, Howard Hughes. This book tells the story of the Republic airplane in detail, and reveals for the first time the reasons behind that company's risky decision to enter the commercial aircraft market, and the cause of the tragic crash of XR-12 Ship Two. In all, this is a classic and compelling story of aeronautical achievement, and failure, at a most tumultuous time in American aviation history.



ISBN 978-1-58007-202-1
52995
9 781580 072021

$29.95

Printed in the U.S.A.
ISBN 978-1-58007-202-1
SP163P

SPECIALTY
39966 Grand
North Branch, MN 550
(651) 277-1400 / (800) 89
www.specialtypre

P7-BCG-284